Dover Municipal Landfill Superfund Site
Second Consent Decree for RD/RA

Civil Action No. 1:92-cv-406-M

<u>APPENDIX A-1</u>

1991 ROD

(Part 2 of 6)

conditionally phased approach to cleanup the Site; 2) the PRPs do not feel that remediation of the southern plume through groundwater extraction and treatment is justified; 3) the PRPs state that the Proposed Plan did not clearly define the criteria for termination of active on- and off-site groundwater recovery and treatment operations; 4) the PRPs want the compliance boundary at the edges of the Bellamy Reservoir and the Cocheco River to which Site groundwater discharges; 5) the PRPs comment that the EPA preferred multi-layer cap is excessive and that the NHDES minimum design specifications for solid waste landfill caps should be incorporated; 6) the PRPs want a separation of flows between the contaminated groundwater in the interceptor trench and the clean groundwater in the diversion trench; and 7) the PRPs comment that the remediation of the drainage swale sediments to address risk associated with arsenic present in the sediments is overprotective.

The alternative that the PRPs submitted includes phasing the cleanup at the Site. Phase 1 includes the construction of a NHDES solid waste cap over the Landfill. They commented that if this remedial action was sufficient to achieve Site cleanup objectives, further action would not be needed and would not be implemented, and if further action were judged to be needed, additional phases could be sequentially implemented. Phase 2 includes the installation of a groundwater interception trench upgradient of the Landfill; Phase 3 includes the installation of a groundwater interceptor trench downgradient of the Landfill with collection and treatment of intercepted groundwater and Phase 4 includes the installation and operation of an off-site groundwater extraction and treatment system.

The public health evaluation report submitted by the PRPs commented on the methodologies employed by and the uncertainties associated with the baseline risk assessment of the RI.

X. THE SELECTED REMEDY

The remedy selected for the Dover Municipal Landfill Site, source control alternative SC-7/7A and a combination of the management of migration alternatives MM-2 and MM-4, addresses all contamination at the Site.

A. Interim Groundwater Cleanup Levels

Interim cleanup levels have been established for contaminants of concern identified in the baseline risk assessment found to pose an unacceptable risk to either public health or the environment. Interim cleanup levels have been set based on the appropriate ARARs (e.g. Drinking Water MCLGs and MCLs) if available, or other suitable criteria. Periodic assessments of the protection afforded by remedial actions will be made as the remedy is being implemented and at the completion of the remedial action. At the time that all the interim cleanup levels described below have been achieved, a risk assessment shall be performed on the residual groundwater contamination. This risk assessment of the residual groundwater contamination shall follow EPA procedures and will assess the cumulative risks for carcinogens and non-carcinogens posed by consumption of groundwater. If the risks are not within EPA's risk levels for carcinogens and non-carcinogens, then the remedial action will continue until protective levels are attained, or the remedy is otherwise deemed protective.

Because the aquifer at and beyond the compliance boundary for the Site is a Class IIB aquifer, which is a potential source of drinking water, MCLs and non-zero MCLGs established under the Safe Drinking Water Act are ARARs.

Interim cleanup levels for known and probable carcinogenic compounds (Class A and B) have been set at the appropriate MCL given that the MCLGs for these compounds are set at zero. In the absence of an MCLG, an MCL, a proposed drinking water standard or other suitable criteria to be considered (i.e. health advisory, state criteria), a cleanup level was derived for carcinogenic effects based on a 10^{-6} excess cancer risk level considering the ingestion of ground water.

Interim cleanup levels for the Class C, D and E compounds (possible carcinogens, not classified, and no evidence of carcinogenicity) have been set at the MCLG. Interim cleanup levels for compounds in ground water exhibiting non-carcinogenic effects have been set at the MCLG. In the absence of a MCLG or other suitable criteria to be considered, interim cleanup levels for non-carcinogenic effects have been set at a level thought to be without appreciable risk of an adverse effect when exposure occurs over a lifetime.

EPA has determined that the Safe Drinking Water Act (SDWA) MCL for arsenic in groundwater is relevant but not appropriate to this site and therefore is not an ARAR. Since naturally occurring levels of arsenic in the groundwater at and around the site are suspected of being greater than the SDWA MCL for this substance, based on field sampling and relevant literature, it may be technically impracticable for any cleanup technology to reduce arsenic levels below background to the SDWA MCL. Given that the Resource Conservation and Recovery Act (RCRA) regulations establish cleanup levels for arsenic in the groundwater at the same point as the SWDA MCL (50 ug/l) or at background levels, whichever is higher, RCRA sets a more appropriate flexible standard for the arsenic cleanup level for this Site.

Though the interim cleanup level for arsenic is based on the RCRA MCL of 50 ug/l, data has indicated that arsenic occurs naturally in groundwater at the Site. It is the intent of EPA to establish the background level for arsenic in groundwater prior to or during the remedial design. In accordance with RCRA, cleanup levels for arsenic will be set at 50 ug/l or background, whichever is higher. Until background levels for arsenic in groundwater is determined, the interim cleanup level will be set at 50 ug/l.

Table 1 below summarizes the Interim cleanup levels for carcinogenic and non-carcinogenic contaminants of concern identified in ground water.

TABLE 1: INTERIM GROUND WATER CLEANUP LEVELS

Carcinogenic Contaminants of Concern (Class)	Interim Cleanup Level (ppb)	Basis	Level of Risk
Arsenic (A)	50#	MCL[a]	$2.0x^{-04b}$
Benzene (A)	5	MCL[c]	$4.1x^{-06}$
1,1 Dichloro-ethylene (C)	7	MCLG	$1.2x^{-04}$
1,2 Dichloro-ethane (B)	5	MCL	$1.3x^{-05}$
Methylene chloride (B)	5	pMCL[d]	$1.1x^{-06}$
Tetrachloro-ethylene (B)	5	MCL	$7.3x^{-06}$
Trichloro-ethylene (B)	5	MCL	$1.6x^{-06}$
Vinyl Chloride (A)	2	MCL	$1.3x^{-04}$
		SUM	$4.8x10^{-4}$

Non-carcinogenic Contaminants Concern	Interim Cleanup Level (ppb)	Basis	Target Endpoint of Toxicity	Hazard Index
Arsenic	50#	MCL	keratosis	1.4
Chloroethane	14000	RfD	developmental	1.0
Tetrahydrofuran	700	RfD[e]	liver	10.0
Acetone	700	NHDPHS[f]	liver	0.2
Methyl Ethyl Ketone	200	HA[g]	fetotoxicity	0.1
Methyl Isobutyl Ketone	350	NHDPHS	liver, kidney	0.2
Toluene	1000	MCL	liver, kidney	0.14

Due to the presence of naturally occurring arsenic at and around the Site, the cleanup levels will be 50 ug/l (MCL) or background, whichever is higher, as determined by the EPA and NHDES during predesign and design activities.

a - Maximum Contaminant Level, Resource Conservation and Recovery Act.

b - The cleanup level for arsenic in groundwater has been set at the MCL of 50 ppb. The carcinogenic risk posed by arsenic at 50 ppb in groundwater will approximate 2 in 1,000. However, in light of recent studies indicating that many skin tumors arising from oral exposure to arsenic are non-lethal and in light of the possibility that the dose-response curve for the skin cancers may be sublinear (in which case the cancer potency factor used to generate risk estimates will be overstated), it is Agency policy to manage these risks downward by as much as a factor of ten. As a result, the carcinogenic risks for arsenic at this Site have been managed as if they were 2 in 10,000. (See EPA memorandum, "Recommended Agency Policy on the Carcinogenic Risk Associated with the Ingestion of Inorganic Arsenic" dated June 21, 1988.)

c - Maximum Contaminant Level, Safe Drinking Water Act

d - Proposed Maximum Contaminant Level

e - A Reference Dose of .002 mg/kg/day was used to derive the interim cleanup level and associated Hazard Index. (See memo from P. Hurst to R. Duwart dated May 3, 1990 - Appendix C) An uncertainty factor of),000 is associated with this RfD. Because of this very high uncertainty factor, a Hazard Index of 10 is considered acceptable.

f - New Hampshire Department of Public Health Services Drinking Water ·-iteria

g - EPA Health Advisory

These cleanup levels must be met at the completion of the remedial action at the point of compliance, which in accordance with the NCP, is established at and beyond the edge of the existing waste area. The existing waste area includes the landfill and the leachate trench surrounding it. After construction of the remedy the point of compliance will be the outer wall of the interceptor trench. EPA has estimated that these cleanup levels will be obtained within 5 to 7 years for the eastern plume and in less than 10 to 24 years for attainment in the southern plume after implementation of the source control component.

While these interim cleanup levels are consistent with ARARs (or suitable To Be Considered criteria) for groundwater, a <u>cumulative</u> risk that could be posed by these compounds may exceed EPA's acceptable risk range for remedial action. Consequently, these levels are considered to be <u>interim</u> cleanup levels for groundwater. In addition, once all these levels are achieved for each compound, EPA expects that due to different rates of attenuation for each compound, levels of most will be below these interim cleanup levels. Thus, when all of the interim cleanup levels have been attained, a risk assessment will be performed on residual groundwater contamination to determine whether the remedial action is protective. Remedial actions shall continue until protective concentrations of residual contamination have been achieved or until the remedy is otherwise deemed protective by EPA. These protective residual levels shall constitute the final cleanup levels for this Record of Decision and shall be considered performance standards for any remedial action.

B. Sediment Cleanup Levels

The cleanup level for arsenic, in the sediments of the drainage swale, has been set at a level deemed protective for environmental receptors. The drainage ditch surrounding the Landfill conducts surface water to a drainage swale which empties into the Cocheco River. Arsenic levels in the drainage swale range from 36 ppm at the top of the swale, to 99 ppm at the confluence of the swale with the Cocheco River. Arsenic levels in the sediments of the landfill perimeter drainage ditch were found at 51 and 210 ppm.

The National Oceanic and Atmospheric Administration (NOAA) has analyzed data collected worldwide using a variety of methods to determine the probable levels where adverse biological effects would occur for most contaminants. The chemical concentrations observed or predicted by the different methods to be associated with biological effects were sorted. The lower 10th percentile (Effects Range Low or ER-L) was identified indicating the low end of the range of chemical concentrations at which an adverse effect was observed or predicted. The median concentration (Effects Range Median or ER-M) was identified as representative of the concentration above which adverse effects were frequently or always observed or predicted among most species. These ER-L or ER-M values are not to be construed as NOAA standards or criteria, but as guidelines by which sediment contamination can be evaluated.

The levels of arsenic found in the sediments in the drainage swale exceed both the NOAA ER-L and ER-M for arsenic. The ER-L is 33 ppm, that is, 10 percent of the available data showed some adverse affect occurred at an arsenic level of 33 ppm. The ER-M is 85 ppm, a concentration at which 50 percent of the data demonstrated an adverse response.

The observed concentrations of arsenic at the site were evaluated in conjunction with the associated physical parameters, specifically total organic carbon (TOC), and grain size, which contribute to the bio-availability of the arsenic; and with the NOAA guidelines. The evaluation indicates that a 33 ppm cleanup level corresponding to the ERL would be conservative cleanup level. A cleanup level of 50 ppm would be justified, and would provide for protection of the environment.

This 50 ppm cleanup level must be met at the completion of the remedial action at and beyond the point of compliance. Thus, the drainage swale east of the Landfill and down to the Cocheco River and the sediments that have accumulated at the convergence of the swale and the river must meet this cleanup level.

C. Description of Remedial Components

The source control portion of the remedy will involve the following key components:

Use of on-site material from the perimeter of the Landfill to recontour the existing Landfill to achieve the necessary slope for drainage;

Construction of a multi-layer cap over the recontoured Landfill;

Construction of a leachate/groundwater extraction system and clean groundwater diversion system provided by a perimeter interceptor trench, extraction wells or a combination of the two;

Installation and operation of an on-site groundwater/leachate treatment system with discharge to the Cocheco River for SC-7 and discharge to POTW for SC-7A;

Methane gas collection and passive venting;

Construction of a surface run-on/run-off diversion system with sedimentation/ detention basins; and

Limited drainage swale sediment removal and consolidation under the Landfill cap.

Recontouring involves the moving of the existing Landfill perimeter soils and debris from the toe of the Landfill side slopes, as well as the perimeter drainage ditch sediment, on top of the Landfill to contour features of the Landfill prior to capping. Recontouring will be done to provide adequate slopes to allow for proper surface water drainage from the waste pile area. Recontouring will also reduce the amount of imported clean fill required to obtain these slopes. Approximately 1,200,000 cubic yards of imported soil will be necessary to cover the 55-acre Landfill if the maximum allowed 5% slope is used. This volume is reduced to approximately 850,000 cubic yards if the

Landfill is recontoured. For a minimum 3% slope, the amount of imported soil could be reduced by another 20-30% from the approximately 550,000 cubic yards. Reductions in the amount of imported soil would translate to a proportionate reduction in truck traffic, congestion, roadway damage, noise and dust. It will also significantly reduce the cost of the cap. The ultimate slope will be determined during design.

During recontouring, waste material at the perimeter of the Landfill would be uncovered and hot spots may be encountered. To minimize this possibility, a preliminary assessment would be performed consisting of geophysics and test pit exploration before the commencement of recontouring activities aimed at limiting the excavation to areas containing predominantly soils, debris, and municipal waste. If, however, hot spots are exposed, the material would be tested and removed, treated, and disposed of off-site in accordance with RCRA and state hazardous waste laws.

The multi-layer cap (also referred to as a composite cap) prevents direct infiltration of precipitation into the Landfill to minimize the subsequent generation of leachate. Figure 10 is a cross-section of a typical multi-layer cap. This multi-layer cap consists of the following layers (from top to bottom):

- Top soil
- Common fill
- Geosynthetic fabric
- Drainage layer
- Composite low permeability layer consisting of a flexible membrane liner over a low-permeability material
- Geosynthetic fabric
- Gas vent layer

The top layer of the multi-layer cap consists of two components: (1) a vegetative top soil, selected to minimize erosion and, to the extent possible, promote drainage off the cover and (2) a soil component comprised of common fill, the surface of which slopes uniformly at least 3 percent but not more than 5 percent.

The drainage layer shall have a minimum hydraulic conductivity of 1×10^{-2} cm/sec which will effectively minimize water infiltration into the low-permeability layer. This layer will have a final slope of at least 3 percent after settlement and subsidence to allow the infiltrated water to flow along the low-permeability liner and not collect, or "pool", in any one location along the low-permeability liner. The drainage layer also provides a protective bedding for the flexible membrane liner (FML). There are generally two options for the materials used to construct this layer: (1) 12 inches of soil (coarse sands) or (2) a geocomposite material (geonet between two layers of geotextile) with equivalent performance characteristics. The largest factor in determining the material to be utilized will be the depth of protection needed to prevent the maximum frost penetration of the low-permeability layer. Cycles of freezing and thawing may cause cracking, lessening of density, and loss of strength to the low-permeability layer. If a geocomposite material is utilized as the drainage layer, the thickness of the vegetative layer must be protective such that the maximum depth of frost penetration will not infiltrate the low-permeability layer.

The third layer is the two-component low-permeability layer, lying wholly below the maximum depth of frost penetration, that provides long-term minimization of water infiltration into the underlying wastes. This low-permeability layer consists of a 40-mil (1.0 mm) minimum thickness flexible membrane liner component and a compacted soil component with a minimum thickness of at least 24 inches and a maximum in-place saturated hydraulic conductivity of 1 X 10^{-7} cm/sec. There are several alternative materials that can be used for the low-permeability layer; clay, a soil/bentonite mixture or a bentonitic blanket. Regardless of which material is used, it must meet the criteria of having a hydraulic conductivity of 1 x 10^{-7} cm/sec. The criteria for selecting which material to use for the low-permeability layer are availability, implementability, and cost.

A gas vent layer between the Landfill wastes and the low-permeability layer shall be installed. This layer is generally made up of 12 inches of coarse-grained, porous materials (similar those used in the drainage layer) that allow gases emanating from the wastes buried in the landfill to be collected. Vent structures will be installed into this layer, allowing the gases to vent to the atmosphere. These gases shall be tested, and if needed, additional measures, such as, but not limited to, the installation of carbon canisters, will be implemented to reduce odors and VOC emissions.

Filter layers (geotextiles) are likely to be needed above the drainage layer, above the gas vent layer and between any other layers comprised of soils of greatly different particle sizes, to prevent one from migrating into the other. The filters may be constructed of graded soil materials or geosynthetic materials.

This multi-layer cap represents the state-of-the-art in landfill cap design and as such is as a reliable and effective cap as can currently be designed. The cap will be designed to meet or exceed the performance requirements set forth in ARARs including 40 CFR 264.111, 40 CFR 264.310 and the guidance document <u>Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>, July 1989 (EPA/530-SW-89-047) (Technical Guidance) or in a manner to achieve performance equivalent to that of ARARs.

The purpose of the interceptor trench/extraction well system is to actively lower the groundwater table level beneath the Landfill so that the waste material is no longer in contact with the groundwater that may migrate off-site. Figure 14 shows a typical groundwater depression caused by an interceptor trench. The groundwater/leachate recovery system consists of approximately 2,200 feet of interceptor trench installed to approximately 25-feet of depth on the downgradient side of the Landfill, at the historical boundaries of the Landfill, to collect contaminated groundwater. The length of the interceptor trench vertical barrier (impermeable membrane) will extend the full 6,100 feet around the perimeter of the existing (55-acre) Landfill. The actual depth will depend on the results of hydrogeologic and geotechnical engineering studies conducted during predesign. The 25-foot depth represents the approximate point at which the lower permeability interbedded zone begins. Inside the trench, a perforated pipe wrapped with filter fabric and drainage net would be laid and connected to a series of manholes. Submersible pumps with high/low switches will be housed inside the manholes to extract the collected groundwater and leachate.

The upgradient portion of the trench serves as a diversion system for the upgradient clean groundwater. The upgradient groundwater is diverted to prevent clean groundwater from possible contact with the landfill wastes, thus reducing the volume of contaminated groundwater requiring treatment. The clean groundwater flowing into this trench would be diverted to either the wetlands or the Cocheco River without mixing with contaminated groundwater. The determination as to the ultimate discharge location will be made during design.

Extraction wells, alone or in conjunction with the interceptor trench, may be utilized, especially where contaminated groundwater flows from the Landfill at a depth greater than 25 feet. The extraction wells can be placed at points around the Landfill to optimize the extraction of the more highly contaminated areas of the plume. An example of this would be the installation of an extraction well on the edge of the landfill, closest to the monitoring well B-2U. The extraction well will collect not only leachate emanating from under the Landfill, but through draw down, can also "pull back" and extract the contaminated groundwater currently detected in well B-2U. This will prevent this contaminated groundwater from flowing past B-2U and entering into the Cocheco River, or discharging through seeps in the drainage swale and volatilizing into the atmosphere.

Monitoring wells will be installed in the central portion of the Landfill for the following purposes: to determine groundwater contamination levels directly under the Landfill; to detect contaminants that may have pooled under the Landfill and on top of the marine clay layer; and to monitor water table declines within and beneath the Landfill. The installation of extraction wells in the landfill will supplement contaminated groundwater and leachate extraction from under the Landfill and further lower the water table beneath the Landfill. The number and location of these wells will be determined during design.

The implementation of the contaminated groundwater and leachate collection system, the upgradient diversion trench and the installation of extraction wells within the Landfill will be optimized so as to minimize redundant functions of each individual component. In addition the components, as a complete system, will be designed to achieve the objectives of lowering the groundwater beneath the waste materials, preventing clean groundwater from contact with the wastes or increasing the amount of contaminated groundwater requiring treatment, and preventing contaminated groundwater and leachate from exceeding SDWA MCLs at and beyond the compliance boundary.

The groundwater/leachate treatment system selected for the Site must be able to address metals, organics, and potentially high chemical and biochemical oxygen demand levels. A powdered activated carbon treatment system, similar to the PACT™ System, has been selected to treat the contaminated groundwater/leachate. However, if during pre-design pilot studies it is determined that this system will not be as effective or efficient as an air stripping system, preceded by metals precipitation, this alternate treatment system may be employed.

The Powered Activated Carbon Treatment System (PACT™) consists of the following steps. Collected groundwater would first enter an aeration tank to remove VOCs; activated carbon present in the tank would remove non-volatile organic chemicals from the water. The water would then pass through a settling tank where flocculation, coagulation, and precipitation processes takes place to remove metals and suspended solids. Precipitation reduces the solubility of iron, nickel, chromium and other metals so that tiny particles of the metals are produced. Once a precipitate forms, the flocculation tank allows the particles to collide and adhere due to flocculating agents. The heavier metals precipitates and solids then settle at the bottom of the tank in the form of sludge. The sludge will tested to determine if it is a RCRA waste and then disposed of off-site in compliance with ARARs. The water then passes through a multi-media filter before being discharged. The effluent from the groundwater treatment process would have to meet the substantive requirements of NPDES for discharge to the Cocheco River and/or discharge to the wetlands. A schematic of this groundwater treatment system is shown in Figure 11. The design flow for the groundwater/leachate treatment systems is approximately 40 gpm.

The two discharge options available are: 1) discharge to the Cocheco River and 2) discharge to the Dover POTW. The POTW option would require the installation of approximately 2.5 miles of sewer line and at least one lift station. Leachate collected from the groundwater/ leachate collection system would be discharged to the local sewer system. Some on-site pretreatment of leachate may be required to meet applicable sewer discharge standards. Table 9 lists the current sewer discharge pretreatment standards for the Dover POTW. At present, the Dover POTW has the extra capacity to handle some pre-treated water from the Landfill, and the capacity is expected to increase further by 1992 with the start-up of the secondary treatment unit, currently under construction. The decision on discharge options will be made during pre-design studies.

The sediment control component provides for predesign sampling to be performed to identify specific areas of sediment deposition along the drainage swale that contain concentrations of contaminants in excess of the arsenic clean-up level. Based on the physical characteristics of the drainage swale, the extent of contamination is expected to be limited. The removal of approximately 300 cubic yards of contaminated sediments is expected to occur through the use of manual labor. However, if the amount of material to be removed is extensive, other mechanical means may have to be employed. The excavated sediments will be deposited back on top of the Landfill prior to the construction of the Landfill cap.

The selected remedy for the management of migration utilizes portions of MM-2 and MM-4 and includes the following elements:

the use of institutional controls, where possible, to prohibit the use of groundwater;

implementation of a long-term groundwater sampling/monitoring program;

pre-design studies which include the installation of additional monitoring wells to further define the lateral extent, depth and mass of the contaminated groundwater;

one or more pump tests to determine the ability and rate that contaminated groundwater can be extracted from the aquifer;

use of natural attenuation processes to attain groundwater clean-up levels in the eastern plume;

installation of several off-site groundwater extraction wells in the southern plume, connection to an on-site treatment system, extraction and treatment of the groundwater and recharge of the treated groundwater to the wetlands or discharge to the Cocheco River.

Institutional controls, where possible, will limit Site access, Site use, prohibit the use of groundwater from the upper aquifer for potable usage and prohibit the disturbance of the marine clay unit between the upper and lower aquifers. These institutional controls include fencing, warning signs, deed restrictions, zoning changes, and other actions which will prohibit the use of contaminated groundwater. The City of Dover has already passed a zoning ordinance restricting the use of groundwater within 1,500 feet of the Landfill as a potable water supply. The Town of Madbury has proposed to take similar action.

The RI and FES investigations indicate that contaminants exceeding MCLs have migrated from the Landfill into the groundwater to the south and the east of the site. Since ARARs are not met in the groundwater at and beyond the point of compliance and the risk to human health is outside the EPA acceptable risk range in this area, sufficient justification exists for instituting active groundwater treatment in both the southern and eastern plumes. However, groundwater modeling has shown that in the eastern plume, natural attenuation processes such as degradation, adsorption, advection and dispersion will effectively cleanup the groundwater within 5 to 7 years after the implementation of the source control portion of this remedy. This being the case, EPA has determined that the NCP's requirement that groundwater be returned to its beneficial uses within a time frame that is reasonable given the circumstances at this Site, will be met by the use of natural attenuation for cleaning up the eastern plume. This determination is in part based on the groundwater modeling information which indicates that active treatment of the eastern plume groundwaters would shorten cleanup times by only a few years.

If the groundwater cleanup levels in the eastern plume have not been attained within the estimated time frame of 5 to 7 years through natural attenuation processes, or if it becomes apparent that there will be a significant increase in the original estimated time frame, then an active restoration system will be evaluated and implemented for the eastern plume.

An active groundwater treatment remedy is selected for the contaminated groundwater in the southern plume, which extends in the direction of the Bellamy Reservoir. While the RI and FES investigations indicate that the groundwaters around the Site, in both the southern and eastern plume directions are in excess of SDWA MCLs, these levels are of particular concern in the southern plume because of their proximity to the Bellamy Reservoir. From the inception of the RI, a primary concern at the Site has been the protection of this reservoir which is a drinking water source for seven municipalities. Data indicates groundwater in the southern plume, containing levels of contaminants significantly above MCLs, has migrated from the Landfill to within approximately 900 feet of the reservoir.

In addition, it is estimated that if these contaminants are left to naturally attenuate, it would take from 10 to 24 years to attain cleanup levels after the implementation of the source control alternative. During such a period of natural attenuation, which may be up to 27 years when the years for construction of the source control measures are taken into account, the groundwater contaminants would continue to exceed ARARs. A 27 year period for cleanup does not constitute a reasonable time-frame for cleanup at this site. Also, during this 27 year period contaminants, if left to naturally attenuate, could reach and pollute the waters of the Bellamy Reservoir. Therefore, a groundwater extraction and treatment system will be implemented to return contaminant levels to MCLs as soon as practicable and to manage the plume so as to prevent it from contaminating the Bellamy Reservoir.

The groundwater extraction system includes a low rate collection of contaminated groundwater which has migrated into the wetlands adjacent and in a southern direction from the Landfill. Extraction wells will be installed at off-site locations and will intercept contaminated groundwater in the direction of flow. Groundwater collected by the extraction wells will collectively be pumped at an approximate total of 50 gpm to a treatment unit on or adjacent to the Landfill. Construction in the wetlands will be required to allow drilling equipment access to new well locations, if necessary, and to install the piping system connecting the extraction wells to the treatment system. Once the extraction system is installed (approximately 6 months) the affected area will be restored.

Groundwater treatment would be similar to that described in the previous source control remedy except for the required treatment capacity. The treated groundwater will be recharged to the wetlands to minimize any potential dewatering that may occur due to the extraction system and/or discharged to the Cocheco River. The effluent from the groundwater treatment process would have to meet the substantive requirements of NPDES for discharge to the Cocheco River and/or discharge to the wetlands.

One or more pump tests will be performed during pre-design studies to determine the ability and rate that contaminated groundwater can be extracted from the aquifer. The actual time frame for attaining cleanup levels in this southern area will depend largely upon the data from this pump test(s) and data from the installation of additional monitoring wells to determine the lateral extent and depth of contamination. However, the time frames are expected to be shorter than the estimated 10 to 24 years expected for natural attenuation.

Periodic review and modification of the design, construction, maintenance and operation of the groundwater extraction and treatment system will be necessary. Performance of the system will be evaluated annually, or more frequently, to determine if EPA's acceptable risk range and standards of the design criteria are being met. If not, adjustment or modification may be necessary. These adjustments or modifications may include relocating or adding extraction wells or alternating pumping rates. Switching from continuous pumping to pulsed pumping may improve the efficiency of contaminant recovery and should be evaluated and necessary modifications undertaken. Should new information regarding the extraction and treatment technology exist, it will be evaluated and applied as appropriate.

After the interim cleanup levels have been met a risk assessment will be performed. If the remedy is determined to be protective, the groundwater extraction and treatment system will be shut down. A groundwater monitoring system will then be utilized to collect information each quarter for three consecutive years to ensure that the cleanup levels have been met and the remedy is protective. If these levels are maintained for three years and the remedy is determined to be protective, a long-term monitoring program for the Site, in accordance with RCRA and New Hampshire Hazardous Waste Rules will be implemented. If the risk assessment indicates that the remedy has not been effective, the performance standards and/or the remedy will be reevaluated.

A long-term groundwater sampling and monitoring program will be initiated during pre-design and continue for three years after attaining groundwater cleanup levels to assess the effectiveness of remediation and to confirm that contaminant concentrations in groundwater attain cleanup levels. If at any time the groundwater monitoring data indicates that the cleanup levels will not be met in the eastern plume within 5 to 7 years after the implementation of the source control remedy then a re-examination will be made of the nature and extent of contamination in this plume and this remedy will be adjusted if appropriate.

The groundwater monitoring program will be developed for the following purposes:

- to evaluate the effectiveness of the source control remediation measures designed to prevent groundwater contaminants in excess of SDWA MCLs to migrate beyond the compliance boundary;

- to monitor the reduction of contaminant concentrations over time in order to insure that groundwater cleanup levels will be achieved in the predicted time frames; and

- to determine the lateral extent of migration of the contaminants in the groundwater in the southern plume.

The details of the groundwater monitoring program will be developed during pre-design and design studies and tailored to the specifics of the Site. Additional groundwater monitoring wells will be installed, as needed, in order to ensure that the objectives of the monitoring program are achieved. Specifically, additional wells will be installed during pre-design to further define the lateral extent and depth of contamination in the southern plume. Selected wells will be monitored quarterly upon initiation of remedial design until completion of the remediation. All samples will be analyzed for Hazardous Substance List VOCs, tetrahydrofuran, and arsenic. Specific wells and analytical parameters may be added or deleted depending on sampling results and observed trends.

Frequent monitoring of treated groundwater recharge to the wetlands or discharge to the Cocheco River shall be implemented, as well as monitoring for the effects of dewatering to limit the impact to the wetlands.

The groundwater modelling employed to determine the relative effectiveness of natural attenuation and extraction/treatment in the southern plume, as well as the models employed to predict the impact of the southern plume on the Bellamy Reservoir relied on a number of assumptions which will be tested during pre-design studies. As noted above, the remedy calls for pre-design studies which include the installation of additional monitoring wells to further define the lateral extent and depth of both contaminant plumes as well as pump tests to confirm assumptions concerning the rate at which contaminated groundwater can be extracted from the upper aquifer. If these studies, and any others determined by EPA to be necessary for further delineation of the nature and extent of the groundwater contaminant plumes, disprove fundamental assumptions employed in the models or produce additional data such that EPA, in consultation with the state, determines that active treatment of the southern plume may not be appropriate and necessary to protect human health and the environment, then EPA, in consultation with the state, and in accordance with the NCP, will re-evaluate the use of active treatment for the southern plume.

These pre-design studies will be initiated as soon as possible and no later than the outset of remedial design/remedial action activities and will take place before or during other remedial design activities for the source control and management of migration components of the remedial action; these studies will not delay any design or implementation activities. These studies and any proposal to alter the remedy based on the findings of these studies must be completed and submitted within fifteen (15) months of commencement of remedial design activities. In accordance with the NCP, any proposal to alter the remedy based on new data must evaluate the chosen remedy against the proposed remedy on the nine criteria set out at 40 CFR 300.430(e)(9)(iii).

Since hazardous substances, pollutants or contaminants will remain at the Site, EPA will review the Site at least once every five years after the initiation of remedial action at the Site to assure that the remedial action continues to protect human health and the environment. EPA will also evaluate risk posed by the Site at the completion of the remedial action.

XI. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the Dover Municipal Landfill Site is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, attains ARARs or invokes an appropriate waiver and is cost effective. The selected remedy also satisfies the statutory preference for treatment which permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element. Additionally, the selected remedy utilizes alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

A. The Selected Remedy is Protective of Human Health and the Environment

The remedy at this Site will permanently reduce the risks posed to human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through removal, treatment, engineering controls, and institutional controls, more specifically, the capping of the Landfill, the limited excavation of contaminated sediments, the collection and treatment of contaminated groundwater and leachate in the Landfill and at the perimeter of the waste management area and the extraction and treatment of off-site contaminated groundwater. The wastes deposited at the Landfill will remain in place. Migration of contaminants to surface water, soils, sediments, and groundwater will be blocked and direct contact with contaminants prevented, thus effectively reducing risks. The pathway for the volatilization of contaminants into the air will be eliminated due to the removal of the perimeter drainage ditch as an avenue for contaminant transport. In addition, the implementation of the cap and groundwater/leachate collection system should eliminate risk resulting from the ingestion and dermal contact with the contaminated surface water and sediments in the perimeter drainage ditch. Leachate and contaminated groundwater (on-site and off-site in the southern plume) will be extracted, treated and either disposed of at the POTW, discharged to the Cocheco River, or recharged back to the wetlands.

The remedial actions, as proposed, will be protective of human health and the environment. Capping of the source area will eliminate further groundwater contamination resulting from soil leaching. Toxicity will be reduced through groundwater treatment until contaminant concentrations are protective of human health. Treatment will also retard the migration of the contaminated plume and halt further contamination of the aquifer. A long-term monitoring program will ensure the remedy remains protective of human health and the environment. The final groundwater cleanup levels will be determined as the result of a risk assessment performed on residual groundwater contamination after all interim cleanup levels have been met. Unless the resultant cumulative risk is within the 10^{-4} to 10^{-6} incremental risk range and the cumulative hazard index for similar target endpoints is below the specified level of concern, remedial actions shall continue, until protective levels are attained. Finally, implementation of the selected remedy will not pose unacceptable short-term risks or cross-media impacts since the technologies are proven and will be field tested to reduce operational risks, and special engineering precautions will be used to minimize potential for air releases of contaminants.

B. The Selected Remedy Attains ARARs

This remedy will meet or attain all applicable or relevant and appropriate federal and state requirements that apply to the Site. Substantive portions of environmental laws identified as ARARs and those to be considered for the selected remedial action include, among others:

Chemical Specific

Safe Drinking Water Act - Maximum Contaminant Levels (MCLs)
Resource Conservation and Recovery Act, Groundwater Protection MCLs
National Ambient Air Quality Standards (NAAQS)
Clean Water Act Ambient Water Quality Criteria (AWQC's)
New Hampshire Surface Water Quality Standards
New Hampshire Drinking Water Standards
New Hampshire Ambient Air Quality Standards
New Hampshire Toxic Air Pollutant Regulations

Location Specific

Clean Water Act (CWA) (Protection of Waters & Wetlands)
Executive Order 11990 (Protection of Wetlands)
Executive Order 11988 (Floodplains Restrictions)
40 CFR Part 6 Appendix A
RCRA General Facility Standards for Floodplains/Seismic Areas
Fish and Wildlife Coordination Act
New Hampshire Wetlands Regulations
New Hampshire Hazardous Waste Regulations (Facility siting standards)

Action Specific

Resource Conservation and Recovery Act (RCRA)
HSRA (Land Disposal Restrictions of RCRA)
Clean Air Act (NAAQS and NESHAP)
DOT Rules for Transportation of Hazardous Materials
CWA (NPDES and Pretreatment Standards)
New Hampshire Hazardous Waste Rules
New Hampshire Air Regulations for VOCs
New Hampshire Standards for Pretreatment of Wastes Discharged to a POTW
New Hampshire Rules for Transportation of Hazardous Materials
New Hampshire Regulations for Terrain Alteration
New Hampshire Regulations for Fugitive Dust Control

To Be Considered

New Hampshire Protection of Groundwater New Hampshire Groundwater Quality Criteria
New Hampshire Groundwater Discharge Criteria
New Hampshire Wellhead Protection Program
EPA Risk Reference Doses
EPA Carcinogen Assessment Group Potency Factors
NOAA Technical Memorandum NOSDMA52
Federal Groundwater Protection Strategy & Classification Guidelines

Tables 9, 10, 11 and 12, in Appendix B of this ROD, list all ARARs identified for the Site and whether they are applicable, relevant and appropriate or to be considered. Within each table is also presented a brief synopsis of the requirements and the action to be taken to meet them. Section 2 of the FS, Tables 2-8 through 2-11 lists all ARARs identified for the Site for all the alternatives.

1. Chemical Specific

a. Federal and State Drinking Water Standards

It has been determined by the EPA that the groundwater in the upper aquifer beyond the point of compliance could be a drinking water source were it not contaminated by substances originating from the Dover Landfill. The State of New Hampshire has not yet classified groundwater in the area; however, using the Federal guidelines and classification system, the groundwater adjacent to the Site would be classified as a IIB potential drinking water. While Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) promulgated under the Safe Drinking Water Act are not applicable to groundwater, they are relevant and appropriate to groundwater cleanup because the groundwater may be used as a drinking water source. In addition, the NCP requires that usable groundwaters be restored to their beneficial uses whenever practicable. See 40 CFR 300.430(a)(iii)(F).

In accordance with RCRA, cleanup levels for arsenic in the groundwater will be set at 50 ug/l or background, whichever is higher. (The SDWA MCL for arsenic has been deemed relevant but not appropriate and therefore not an ARAR because naturally occurring levels may be higher than the SDWA MCL.) Prior to or during remedial design, EPA and the state will determine the background level of arsenic at this Site to establish the interim cleanup level.

New Hampshire's Protection of Groundwater regulations (Ws 410) do not establish groundwater quality standards, but do establish groundwater criteria. Included in this criteria is the requirement that no person shall cause the groundwater to contain a substance at a level that the state determines may be potentially harmful to human health or to the environment. Because New Hampshire's regulations do not contain a standard level of control as required by § 121(d)(2)(A)(ii) of CERCLA, they will not be an ARAR. They are, however, to be considered (TBCs) and will be met.

This remedy will attain these ARARs as well as those identified in the tables of Appendix E, and will comply with those regulations which have been identified as TBCs by meeting the groundwater cleanup levels at the Site through the groundwater treatment systems and natural attenuation. Capping of the Landfill will decrease infiltration of precipitation through the Landfill, thus reducing the volume of leachate generated. Treating the leachate and contaminated groundwaters will reduce levels of contamination at the Site to the interim cleanup levels identified in this ROD. Treated groundwater will also meet federal standards, state criteria for drinking water, and the discharge requirements to the Cocheco River and/or of the POTW. Where natural attenuation is employed, federal and state standards will be met within the time frame specified.

b. Federal Clean Air Act and New Hampshire Air Pollution Regulations

Federal Primary and Secondary National Ambient Air Quality Standards (NAAQS) exist for emissions of sulfur oxides, carbon monoxide, ozone, nitrogen oxides and lead and particulate matter whereas the National Emission Standards for Hazardous Air Pollutants (NESHAPs) address VOC emissions from specific sources. Threshold Limit Values (TLVs) provide an extensive list of control levels for workplace environments and, while they are based on the exposure of a select population and not generally transferable to the general public, they are used to assess site inhalation risks for soil removal operations.

New Hampshire's air quality regulations parallel the federal regulations. The specific sections set forth in the tables in Appendix E, establish specific standards for particulate matter and ambient air limits for a large number of toxic air pollutants. In addition, New Hampshire has established limits on VOC emissions from certain industries. Also, the state has promulgated fugitive dust control regulations which require that measures be taken to limit dust from construction and other activities.

These federal and state air standards will guide mitigation measures designed to control the release of particulate matter during the recontouring and excavation at the Site. In addition, the federal and state regulations which set standards for VOC emissions from certain industries will be relevant and appropriate to set limits on the emissions from any treatment system used at the Site. Finally, the state fugitive dust control regulations will guide recontouring activities so that dust is kept to a minimum. In each case the best demonstrated technology will be employed to meet the federal and state requirements.

2. Location Specific

a. Federal and State Wetland and Floodplain Protection

The Clean Water Act, along with Executive Order 11990 (Protection of Wetlands) and state wetland protection standards are applicable to that portion of the remedy constructed in or affecting the wetlands surrounding the Site. These rules prohibit activity adversely affecting a wetland if there exists a practicable alternative which is less detrimental. Constructing the management of migration groundwater extraction system in the wetland is necessary because active management and cleanup of the plume is necessary to meet the remediation objectives of the Site and the contaminant plume lies under the wetland.

In the short term, construction will be conducted to avoid or minimize the damage to flora and fauna within the wetland. Additionally, after construction is completed, restoration of the wetlands will occur in two phases. The first phase, implemented at the time of completion of the construction, will consist of restoring the original topography and establishing shallow rooting vegetation. The second phase, initiated at the completion of the remedy, consists of encouraging the original wetland species to reestablish themselves naturally.

After reviewing the Federal Emergency Management Agency, Floodplain Insurance Rate Maps for the City of Dover, EPA has determined that a portion of the Site is located in a 100-year floodplain. Executive Order 11988 (Floodplain Management) is therefore an ARAR for the Site. These regulations govern construction activities which have a negative impact on a floodplain.

The portion of the Site that lies within the 100-year floodplain is the lower portion of the drainage swale, converging with the Cocheco iver. The limited excavation of contaminated sediments in this area is necessary to meet the remedial objectives, and has little or no adverse impact on the floodplain.

EPA's policy on implementing Executive Orders 11990 (wetlands) and 11988 (floodplains) is contained at 40 CFR Part 6 Appendix A. This Appendix sets forth principles and procedures to govern work in wetlands and floodplains so as to minimize the adverse impacts on these valuable natural resources. These orders, as well as EPA's policy, will be implemented in the construction and maintenance of the remedy.

In accordance with 40 CFR Part 6, Appendix A, the EPA has provided an opportunity for public comment on the work to be undertaken in the wetlands and floodplain by issuing a Proposed Plan for remedial action at this Site, holding a public hearing and receiving pubic comments for 60 days prior to this decision. In addition, a Statement of Findings which determine that there are no practicable alternatives to these remedial actions in the wetlands and floodplain is included in Appendix F.

3. Action Specific

a. State and Federal Hazardous Waste Regulations

RCRA regulations and the current State of New Hampshire hazardous waste regulations are relevant and appropriate to the source control and management of migration portions of the remedy. In those limited instances these regulations conflict, the more stringent regulation will be followed.

Prior to January 1991, the State, by promulgating hazardous waste regulations which were as stringent as, or more stringent than, RCRA regulations, had been authorized by EPA to administer and enforce the hazardous waste program in New Hampshire. However, New Hampshire has promulgated an entirely new set of regulations this year. Some of those regulations are less stringent than RCRA regulations. This new state program is still undergoing revisions and has yet to be approved by EPA. As a result, both federal and state hazardous waste regulations existing at the signing of this ROD must be consulted to employ the more stringent requirements.

Since RCRA-type hazardous wastes were disposed of in the Landfill during its operation and it is suspected that full barrels of RCRA-type substances were buried and may still be leaching inside the Landfill, the cap design and construction for this unit will meet both RCRA and New Hampshire hazardous waste standards. In addition, during the recontouring of the Landfill, hot spots may be encountered. The substances in those hot spots must be removed and treated, transported, and disposed of in accordance with RCRA and New Hampshire requirements. Sludge generated by the groundwater treatment unit(s), if determined to be RCRA-type waste, must also be removed from the Site, transported, and disposed of in accordance with RCRA and the state requirements.

The land disposal restrictions of Hazardous and Solid Waste Amendments of RCRA will apply to those RCRA-type hazardous substances removed from the Site, including those hot spot substances and the treatment unit sludges. Land disposal restrictions will not apply to the movement of sediments from the swale to the area of the Landfill to be capped because, among other reasons, this movement does not constitute placement for purposes of the land disposal restrictions. The contaminants in the swale have been caused by and are contiguous to the Landfill, and their movement back to the Landfill constitutes consolidation within the unit.

C. The Selected Remedial Action is Cost-Effective

In the Agency's judgment, the selected remedy, is cost effective:

the remedy affords overall effectiveness proportional to its costs. Once EPA identified alternatives that were protective of human health and the environment and that either attain, or, as appropriate, waive ARARs, EPA evaluated the overall effectiveness of each alternative by assessing the relevant three criteria--long term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short term effectiveness. The relationship of the overall effectiveness of these remedial alternative were determined to be proportional to their costs.

A summary of the costs associated with each of the source control remedies are presented below. All costs are presented in net present costs.

COST COMPARISON OF SOURCE CONTROL ALTERNATIVES

		Capital Costs	O & M	Present Worth
SC-1	No Action	$ 0	169,000	1,593,400
SC-2	Limited Action	44,400	177,600	1,718,300
SC-5	Recontour/Multi-Layer Cap/ Slurry Wall/ Groundwater Treatment/ Discharge to Cocheco River/ Sediments Cover	31,266,600	221,400	33,353,600
SC-5A	Recontour/Multi-Layer Cap/ Slurry Wall/ Groundwater Treatment/ Discharge to POTW/ Sediments Cover	31,334,600	205,000	33,267,100
SC-7	Recontour/Multi-Layer Cap/ Interceptor/ Diversion Trench/ Groundwater Treatment/ Discharge to Cocheco River/ Sediments Excavation	20,014,800	239,300	22,270,600

SC-7A	Recontour/Multi-Layer Cap/ Interceptor/ Diversion Trench/ Groundwater Treatment/ Discharge to Cocheco River/ Sediments Excavation	20,174,700	211,862	22,171,900

Two of the above alternatives are protective and attain ARARs: SC-5/5A and SC-7/7A. Comparing these alternatives, EPA's selected remedy, SC-7/7A, combines the most cost-effective remedial alternative components that were evaluated. The remedy provides a degree of protectiveness proportionate to its costs. Alternative SC-5/5A is 50 percent more costly than SC-7/7A without providing a commensurate increase in protectiveness. Alternative SC-7/7A, like SC-5/5A, involves the construction of a cap over the landfill and the installation of a groundwater/leachate collection system, but without threatening the integrity of the marine clay layer. The less expensive alternatives, SC-1 (no-action) and SC-2 (limited action), did not meet all ARARs nor were sufficiently protective of human health and the environment.

A summary of the costs for each of the elements of the selected source control remedy is presented below. All costs are net present worth.

Total Costs of Selected Source Control Remedy

Component of Remedy	Present Worth ($)
Multi-layer Cap	14,079,100
Groundwater/Leachate Collection System	1,347,600
Groundwater Treatment System (PACT™)	1,692,700
Limited Sediment Excavation	7,900
Miscellaneous*	4,215,000
TOTAL[1]	21,342,300

* Miscellaneous includes the following: facilities, a drum removal and disposal contingency should hot spots or drums be encountered during recontouring activities, contractor allowances, contingency allowances and general administration.

[1] The total presented does not include $928,400 included in the FS for long-term groundwater, surface water and sediment monitoring over 30 years. Long-term monitoring costs for these media are included under the costs for management of migration portion of the selected remedy.

A summary of the costs associated with each of the management of migration remedies are presented below. All costs are presented in net present costs.

COST COMPARISON OF MANAGEMENT OF MIGRATION ALTERNATIVES

	Capital Costs	O&M Costs ($/Yr)	Present Worth
MM-1 No Action	$ 0	142,800	1,346,500
MM-2 Limited Action	9,400	176,500	1,673,600
MM-3 Groundwater Interceptor Trench/Recharge Trench/ Groundwater Treatment	1,452,200	78,800	2,828,700*
MM-4 Groundwater Extraction Wells and Treatment System	1,503,700	394,200	4,818,000*

* Present worth costs for MM-3 and MM-4 include an additional $892,147 for long-term groundwater monitoring (30 years) that is not accounted for in columns headed "Capital Costs" and "O & M Costs".

Three of the management of migration alternatives attain ARARs, MM-2, MM-3 and MM-4. Comparing these alternatives, EPA's selected remedy, portions of MM-2 and MM-4, combines the most cost-effective remedial alternative components while also providing sufficient protection to human health and the environment. This portion of the remedy provides a degree of protectiveness proportionate to its costs.

The least expensive alternative, MM-1, no action, would meet ARARs in the long term through attainment of groundwater cleanup levels by natural attenuation processes. It does not provide protection of public health and the environment in the short term because use of the contaminated groundwater would not be restricted and the cleanup time frame is not reasonable. Alternative MM-2, limited action, allows for natural attenuation processes to attain groundwater cleanup levels and includes institutional controls to prevent short term usage of groundwater.

Both MM-3 and MM-4 take active measures to cleanup groundwater and to prevent short term and long term impacts of the contaminant plume on the Bellamy Reservoir. Alternative MM-3 involves a passive collection that intercepts and treats contaminated groundwater. Alternative MM-4 actively extracts and treats contaminated groundwater from the aquifer.

Alternative MM-4, which is 187 percent more costly than MM-2, and 70 percent more costly than MM-3, is expected to attain groundwater cleanup levels in a somewhat shorter time frame than MM-2 and MM-3, due to active extraction and treatment. The time frames to attain groundwater cleanup levels in the eastern plume are approximately 5 to 7 years for MM-2, and 3-4 years for MM-3 and MM-4. Since the time frames to achieve the cleanup levels are not significantly different, and because during this time frame the eastern plume contamination is not expected to affect a current drinking water receptor, the EPA selection of natural attenuation (MM-2) for the eastern plume is most cost effective while providing adequate protection of human health and the environment.

The time frames to attain groundwater cleanup levels in the southern plume are approximately 10 to 24 years for MM-2, and less than the 10 to 24 years for MM-3 and MM-4. The FS simulations of the time frames to achieve MCLs for the MM-4 alternative did not take into account the increased hydraulic gradients and groundwater velocities resulting from the greater drawdown created by the extraction wells. The increased groundwater velocities near the extraction wells may result in a remediation time frame somewhat less than that for alternative MM-3. The actual effect of the extraction wells under MM-4 on increasing the groundwater velocities will be a function of the pump rate and aquifer drawdown created by the extraction wells.

In addition to shortening the cleanup time, MM-4 provides immediate protection to the Bellamy Reservoir from the southern contaminant plume. The plume has moved to within 900 feet of the reservoir and, if left to naturally attenuate, contaminants could reach the class A waters of the reservoir. Because of the levels of current groundwater contamination in the southern plume, the time frame for allowing natural attenuation to clean up this plume, and the threat to this important drinking water resource, the costs associated with employing an extraction well/treatment system to remediate the southern plume are justified.

A summary of the costs for each of the elements of the selected management of migration remedy are presented below. All costs are net present worth.

TOTAL COSTS OF SELECTED MANAGEMENT OF MIGRATION REMEDY

PORTION OF REMEDY	PRESENT WORTH COST ($)
I. Capital Costs	
a. Fencing, Gates, Signs	63,300
b. Groundwater Extraction Wells	9,000
c. Groundwater Treatment System (PACT™ System, pipe line and discharge)	671,500
d. Miscellaneous*	379,200
II. Annual Operation and Maintenance (@ $157,680 per year, for 10 years)	968,800
III. Long-term Groundwater Monitoring (@ $76,600) per year for 30 years)	721,600
TOTAL	2,813,400

* Miscellaneous includes the following: miscellaneous facilities (Site trailers, etc.), institutional control administration costs, contractor allowances, engineering, contingency allowances, and general administration.

The costs, taken from alternatives SC-2 and MM-2 in the FS, for the fencing, gates and signs were summed to obtain the costs presented in the above table. The long-term monitoring costs associated with the selected remedy were calculated by EPA using the long-term monitoring of groundwater, surface water and sediments as shown in the FS for SC-2 and MM-2. Specifically long-term monitoring costs include the costs for quarterly sampling of 12 wells (as estimated by SC-2 in the FS) for VOCs, metals and tetrahydrofuran as well as the associated labor, data validation, report writing and administration costs. The actual number of wells sampled, which may be greater than twelve, and the location of these wells will be determined during design.

Note that at the request of EPA, HMM Associates, the FS contractor, submitted an analysis of the costs for the extraction and treatment of a) the eastern plume and b) the southern plume. The costs from this analysis, available in the Administrative Record, have been used to compile the cost table above. A detailed accounting of costs for each source control and management of migration alternative is contained in Section 4 of the FS.

While analyzed separately in this document, the source control and management of migration portions of this remedy are interdependent. Source control measures are necessary for, among other things, the prevention of future contaminant migration into the eastern and southern plumes and the management of migration measures are needed to protect the Bellamy Reservoir from the existing southern plume contaminants and any expansion of that plume during the design and implementation of this remedy.

TOTAL ESTIMATED COST: $24,155,700

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain or, as appropriate, waive ARARs and that are protective of human health and the environment, EPA identified which alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility or volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility and volume through treatment; and considered the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives.

The selected source control alternative SC-7/7A, is similar to SC-5/5A in its long-term effectiveness, permanence, short term effectiveness, and reduction of toxicity, mobility and volume of contaminants through treatment. The selected alternative is far superior to SC-5/5A in the areas of implementability and cost. Alternative SC-5/5A costs 50 percent more than SC-7/7A without providing a corresponding increase in protection. Alternative SC-5/5A also requires the securing of the slurry wall into the marine clay layer which separates the upper contaminated aquifer from the lower drinking water aquifer. This would be a difficult procedure and could affect the integrity of the clay layer. SC-7/7A provides for an interceptor trench/extraction well system which will not affect the clay layer. In addition, the limited sediment excavation of SC-7/7A is easier and quicker to implement, less expensive, and provides a more permanent remedy than the swale cover examined in SC-5/5A.

Alternatives SC-1 and SC-2 are far less protective than both SC-5/5A and SC-7/7A for the long-term. Both alternatives SC-1 and SC-2 do not prevent the migration of contaminants into the groundwater nor do they provide for the reduction of mobility, toxicity or volume through treatment of the contaminants in the groundwater. Natural attenuation processes, acting in the groundwater, may eventually result in the attainment of groundwater cleanup levels, but this would take many decades.

Alternative MM-2 and selected elements of MM-4 were chosen as the management of migration portion of the remedy because of the combined long-term effectiveness and permanence and ability to reduce toxicity, mobility and volume of contaminants through capture and treatment was the most efficient of all alternatives in light of implementability and cost concerns. The principal elements of the remedy consist of extracting groundwater in the southern plume, which has migrated from the Landfill toward the Bellamy Reservoir, and treating the groundwater through the use of a PACT™ process or an air stripper, prior to discharging it to the Cocheco River and/or recharging it back to the wetlands to off-set dewatering. The PACT™ process and the air stripper are proven techniques which provide permanent solutions for contaminated groundwater and have been used successfully at other cleanup sites. Groundwater in the eastern plume is expected to attain groundwater cleanup levels through natural attenuation in a reasonable time frame (5 to 7 years) after implementation of the source control remedy; unlike the southern plume, the eastern plume does not threaten a current drinking water source during the period natural attenuation is to attain groundwater cleanup levels.

Alternative MM-3 is similar to MM-4 in long-term effectiveness and permanence and its ability to reduce toxicity, mobility and volume of contaminants through capture and treatment and also in implementability and costs. However, when short term impacts are considered, MM-4 provides greater protection to the wetlands during installation. In addition, because MM-4 actively extracts the contaminated groundwater, where MM-3 relies on the natural flow of groundwater, cleanup time frames are expected to be faster for MM-4.

Alternative MM-1 is similar to MM-2 in long-term effectiveness, permanence and cost. MM-2 is selected because it provides greater protection of public health and the environment through institutional controls. These controls are especially important to prevent ground water consumption in the short term.

E. The Selected Remedy Satisfies the Preference for Treatment Which Permanently and Significantly reduces the Toxicity, Mobility or Volume of the Hazardous Substances as a Principal Element

The principal element of the selected source control portion of the remedy is the containment of wastes in the Landfill. The principal element of the selected management of migration portion of the remedy is groundwater extraction and treatment. These elements address the primary threat at the Site, contamination of the groundwater with VOCs, tetrahydrofuran and metals (arsenic). The selected remedy satisfies the statutory preference for treatment as a principal element by minimizing leachate from the Landfill, collecting and treating leachate and the contaminated groundwater migrating from the Landfill, and actively extracting and treating the contaminated groundwater posing a potential threat to the nearby drinking water supply reservoir. Treatment is not used for the cleanup of the Landfill because treatment of this large volume of heterogeneous waste is not practical or cost-effective in comparison with capping the waste in place.

XII. DOCUMENTATION OF NO SIGNIFICANT CHANGES

No significant changes from the Proposed Plan have been made to the selected remedies as detailed in the Record of Decision. Minor changes from the Proposed Plan to the Record of Decision include incorporating an arsenic cleanup level for sediments which is protective of the environment rather than simply protective of human health. In addition, accounting errors have been corrected and long-term monitoring full HSL analysis was deemed inappropriate. These corrections reduced the cost of the selected remedy by approximately $1.7 million. Minor changes also include some changes in the ARAR tables to better reflect the actions to be taken at the Site to meet these ARARs and some alterations in the status of the ARARs to accommodate site specific features. Also, EPA has determined that the SDWA MCL for arsenic in the groundwater is not appropriate for this Site and therefore not an ARAR. The RCRA MCL for arsenic will control the setting of this cleanup level.

The selected remedy provides for the limited excavation of contaminated sediments in the drainage swale for the protection of the environment, specifically due to the presence of arsenic in the sediments. An arsenic cleanup level in sediment has been set at 50 ppm, based on Site exceedances of the NOAA Effects Range Low of 33 ppm, and taking into consideration the Effects Range Median of 85 ppm and site-specific data (TOC and grain size). This level is considered protective for fish, waterfowl and other biota inhabiting the Cocheco River. The proposed plan stated a cleanup level for arsenic in sediments for the protection of human health. Since the risks via ingestion and dermal contact with these sediments are within EPA's acceptable risk standards, protection for human health was not justified.

In the Proposed Plan the estimated total cost for the preferred remedy was $25.9 million. The estimated total cost of the remedy in this Record of Decision is $24.2 million. The reduction in costs is in part based on the correction of accounting and overestimated long-term monitoring costs. In combining alternatives to obtain the selected remedy long-term monitoring costs were double counted. Long-term monitoring costs associated with SC-7/7A and MM-4 have been deducted because they are also included in the costs associated with MM-2. In addition, MM-2 included costs for full HSL analysis of groundwater, which has been deemed inappropriate by the EPA because there is no indication that pesticides, poly-chlorinated biphenyls (PCBs) or base-neutral and acid extractable organic compounds (BNAs) are contaminants of concern at this Site.

The SDWA MCL for arsenic in groundwater has been determined to be relevant but not appropriate to this Site and therefore not an ARAR as a result of the possibility of naturally occurring background levels which may exceed the SDWA MCL. The RCRA groundwater cleanup level for arsenic remains both relevant and appropriate because it sets cleanup at 50 ug/l, or background, whichever is higher.

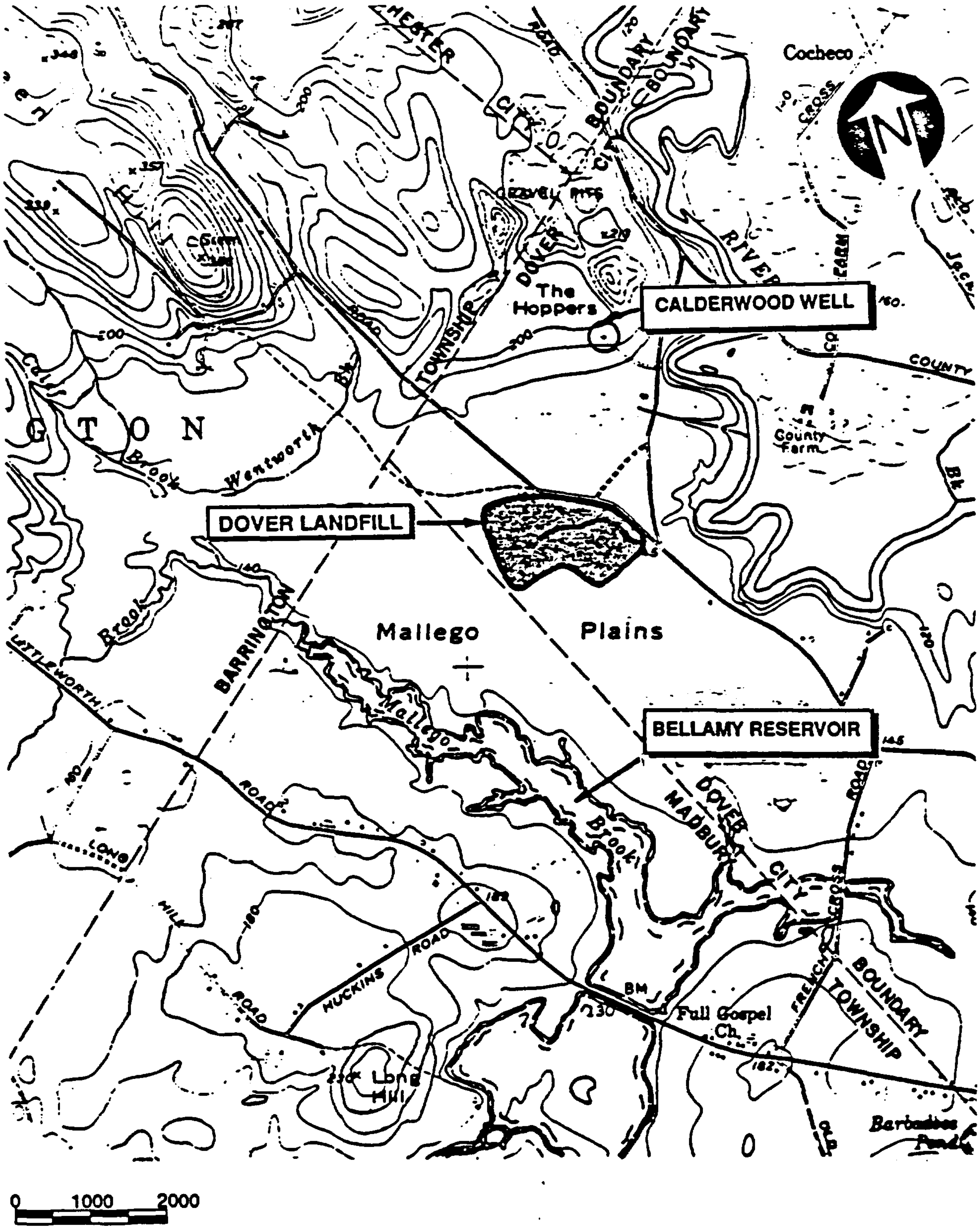
Other minor changes in ARARs may be found in the tables in Appendix E of this ROD Decision Summary.

III. STATE ROLE

The New Hampshire Department of Environmental Services has reviewed the various alternatives and has indicated its support for portions of the selected remedy. The State has also reviewed the Remedial Investigation, Risk Assessment and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate State Environmental laws and regulations. The New Hampshire Department of Environmental Services concurs with the source control and eastern plume management of migration portions of the selected remedy for the Dover Municipal Landfill Site and has reserved a concurrence decision on the southern plume management of migration portion of the selected remedy until pre-design studies have been completed. A copy of the declaration of concurrence is attached as Appendix D.

Appendix A

FIGURES



BASE MAP IS A PORTION OF THE U.S.G.S. DOVER WEST, NH QUADRANGLE
7.5 MINUTE SERIES - 1956 (PHOTO REVISED 1973)

FIGURE 1
LOCATION OF DOVER LANDFILL SITE

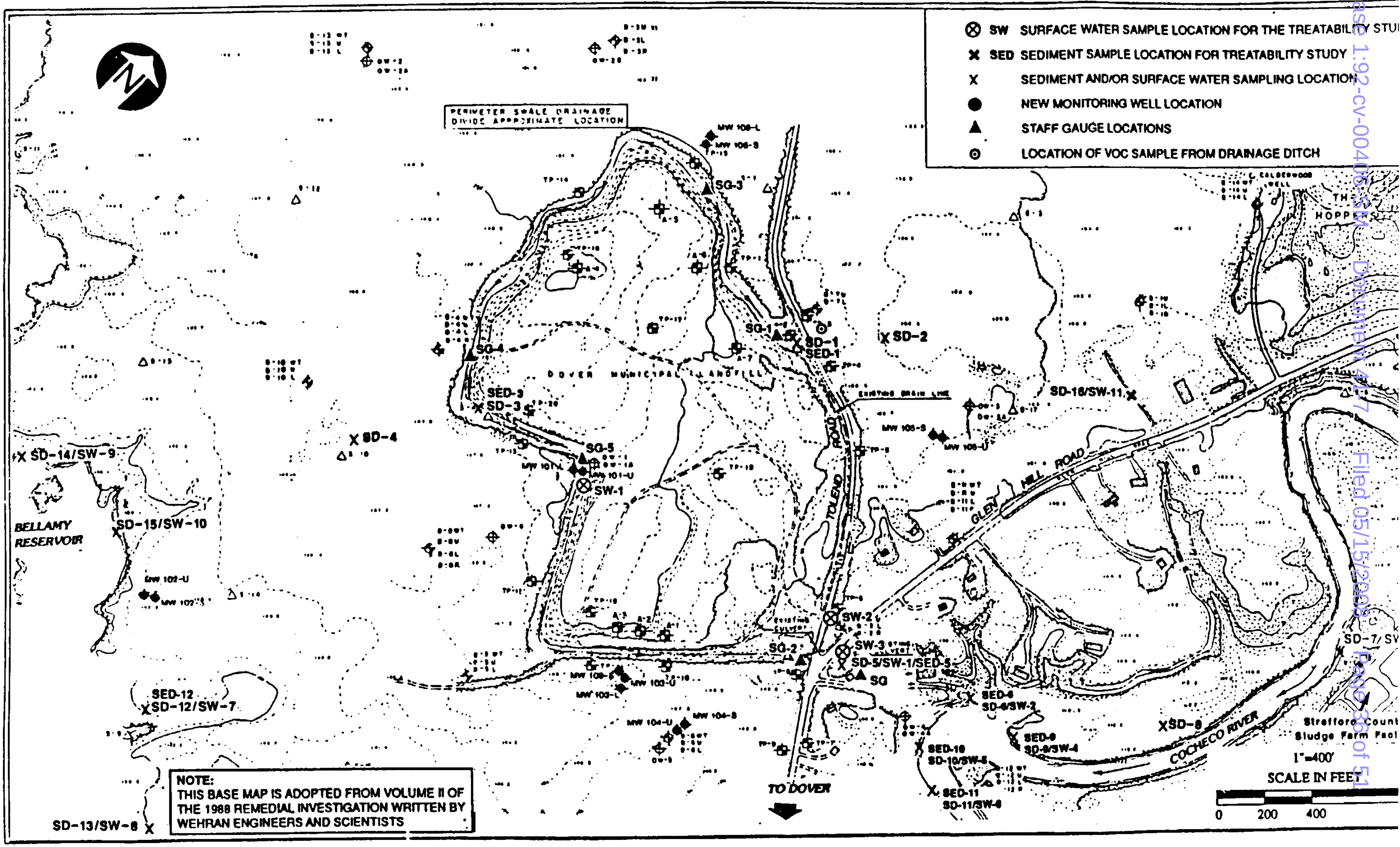


FIGURE 2
WETLANDS STUDY SAMPLING LOCATIONS FOR SEDIMENT AND SURFACE WATER

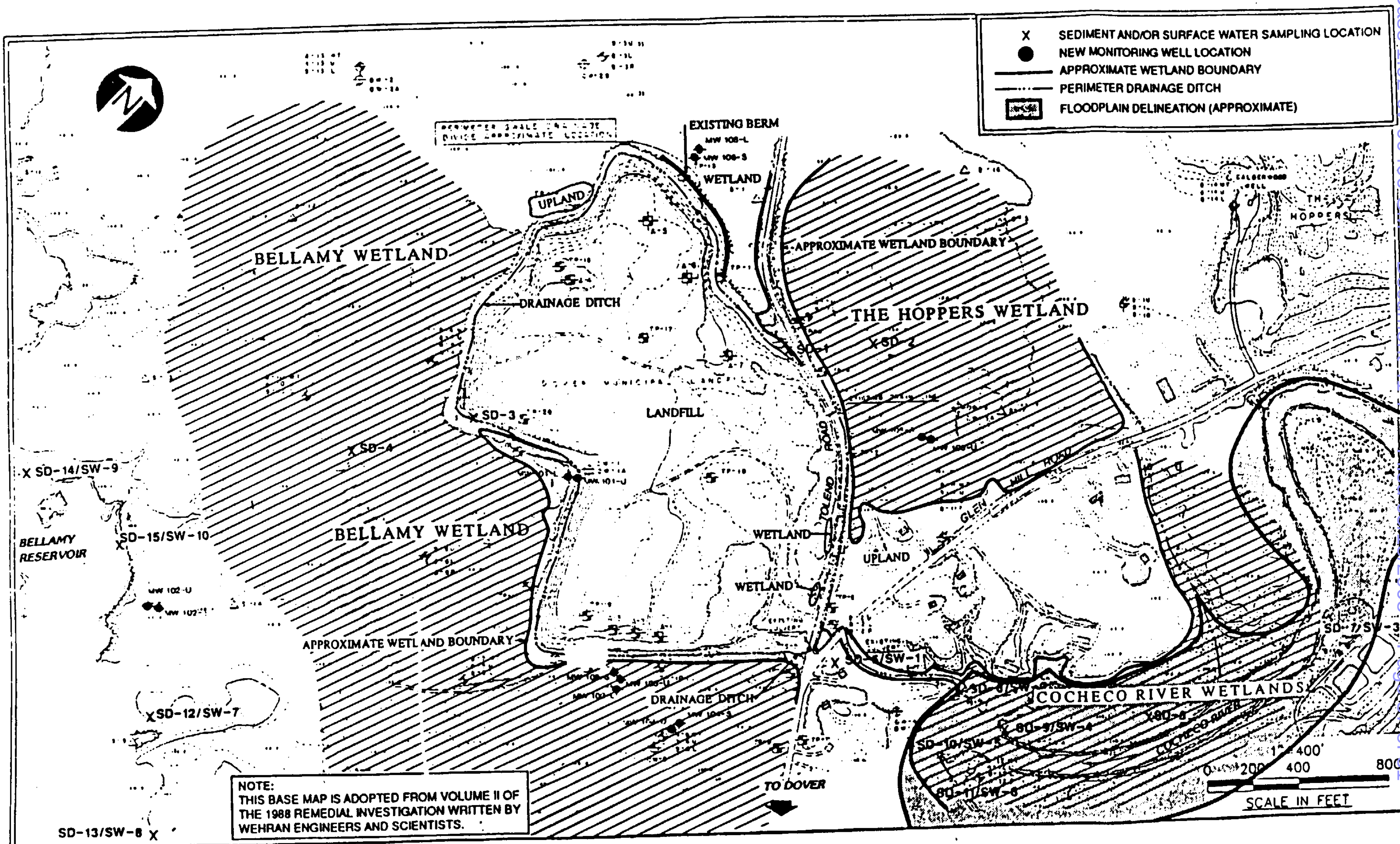


FIGURE 3

WETLANDS AND FLOOD PLAIN DELINEATION

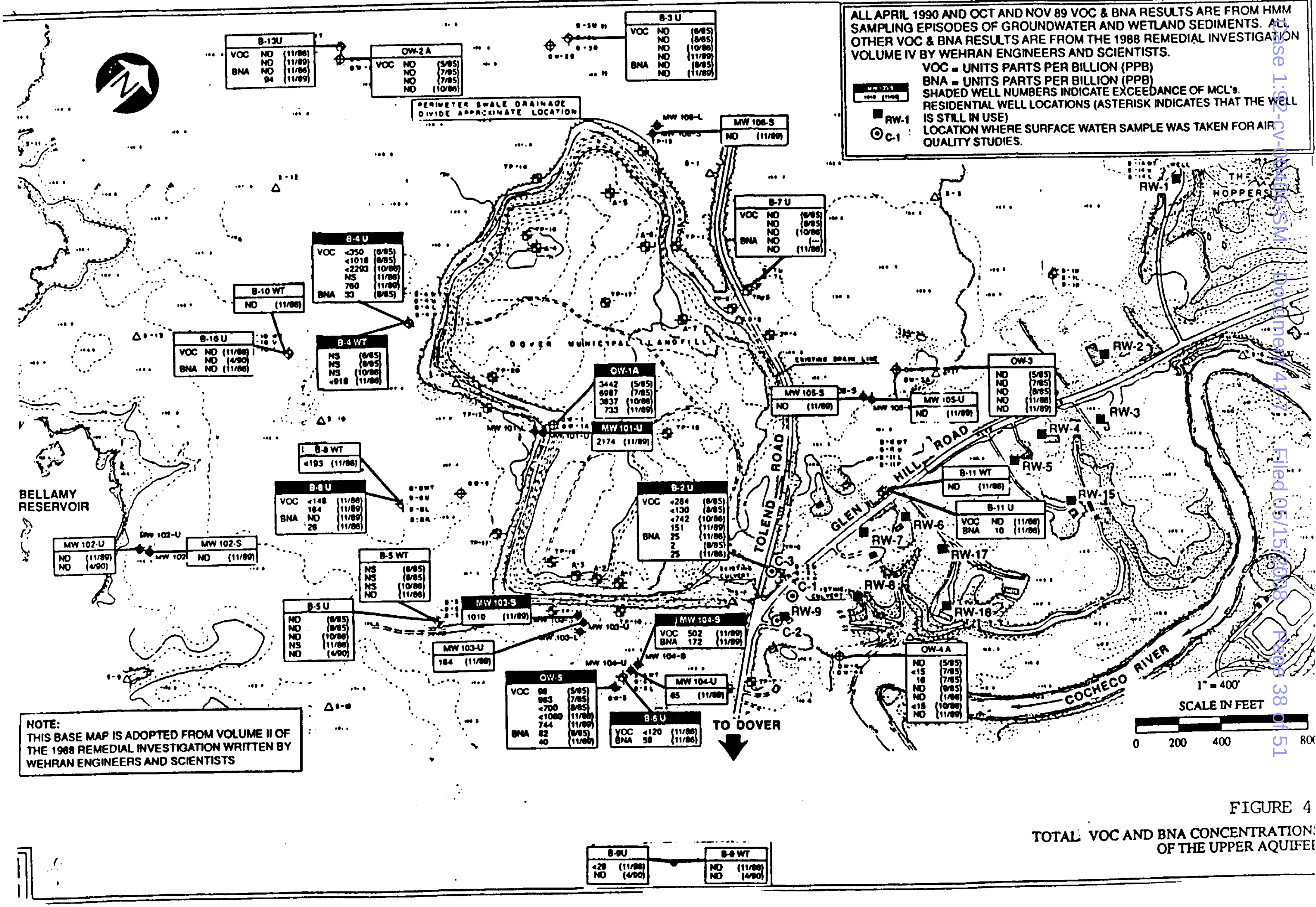


FIGURE 4

TOTAL VOC AND BNA CONCENTRATIONS OF THE UPPER AQUIFER

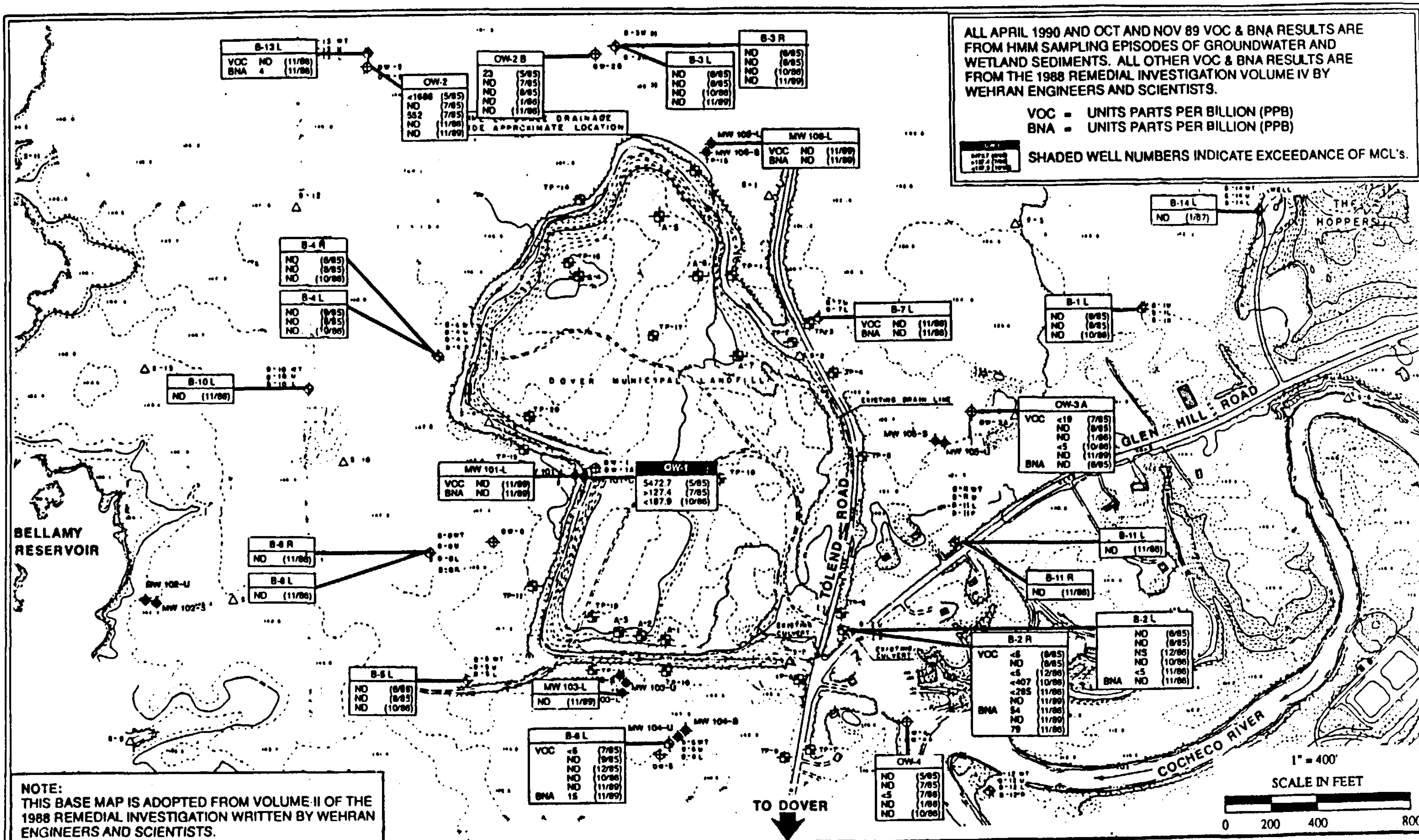


FIGURE 5
TOTAL VOC AND BNA CONCENTRATIONS OF THE LOWER AQUIFER

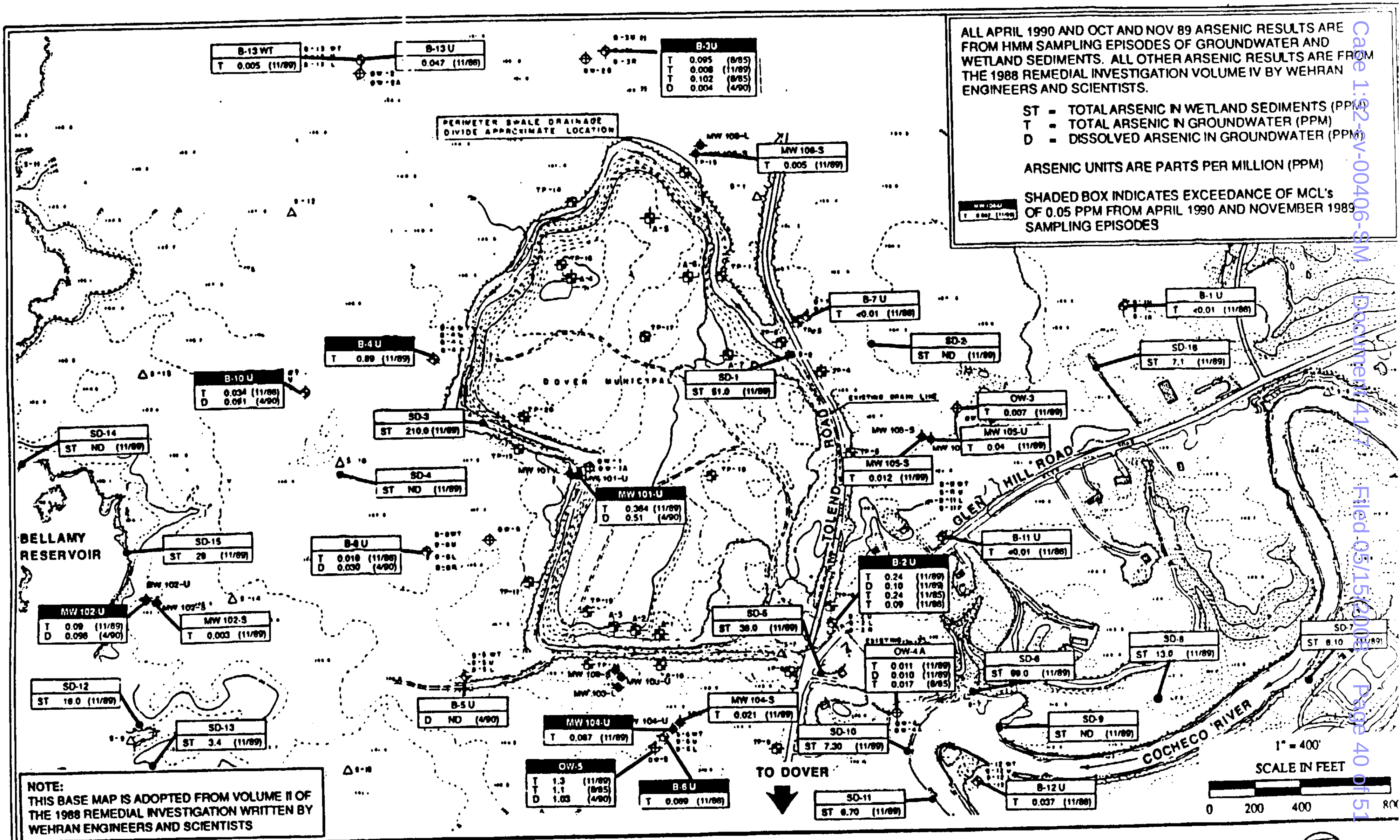


FIGURE 6

ARSENIC CONCENTRATIONS FROM THE UPPER AQUIFER AND WETLAND SEDIMENTS

hm
m

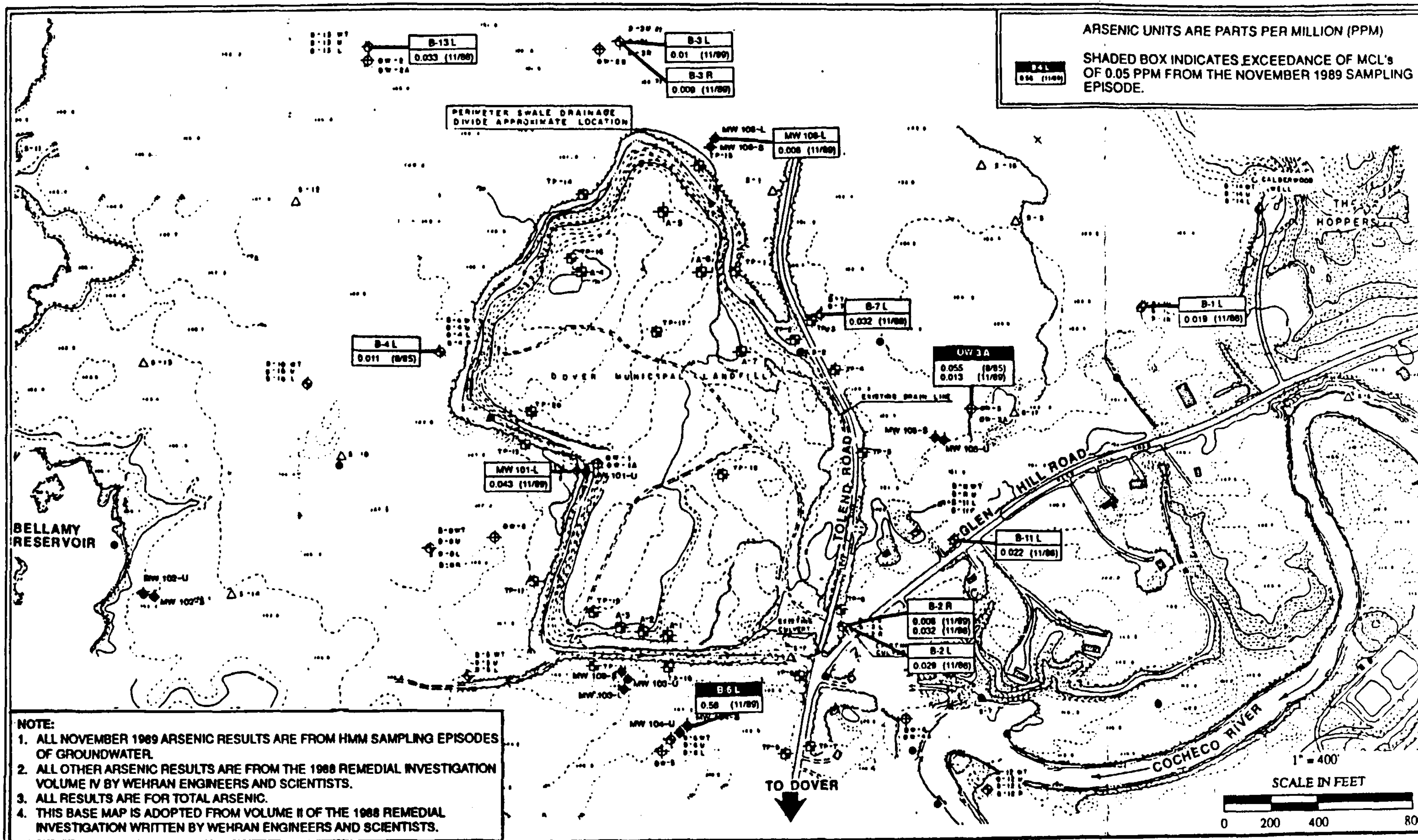


FIGURE 7

ARSENIC CONCENTRATIONS FROM THE LOWER AQUIFER

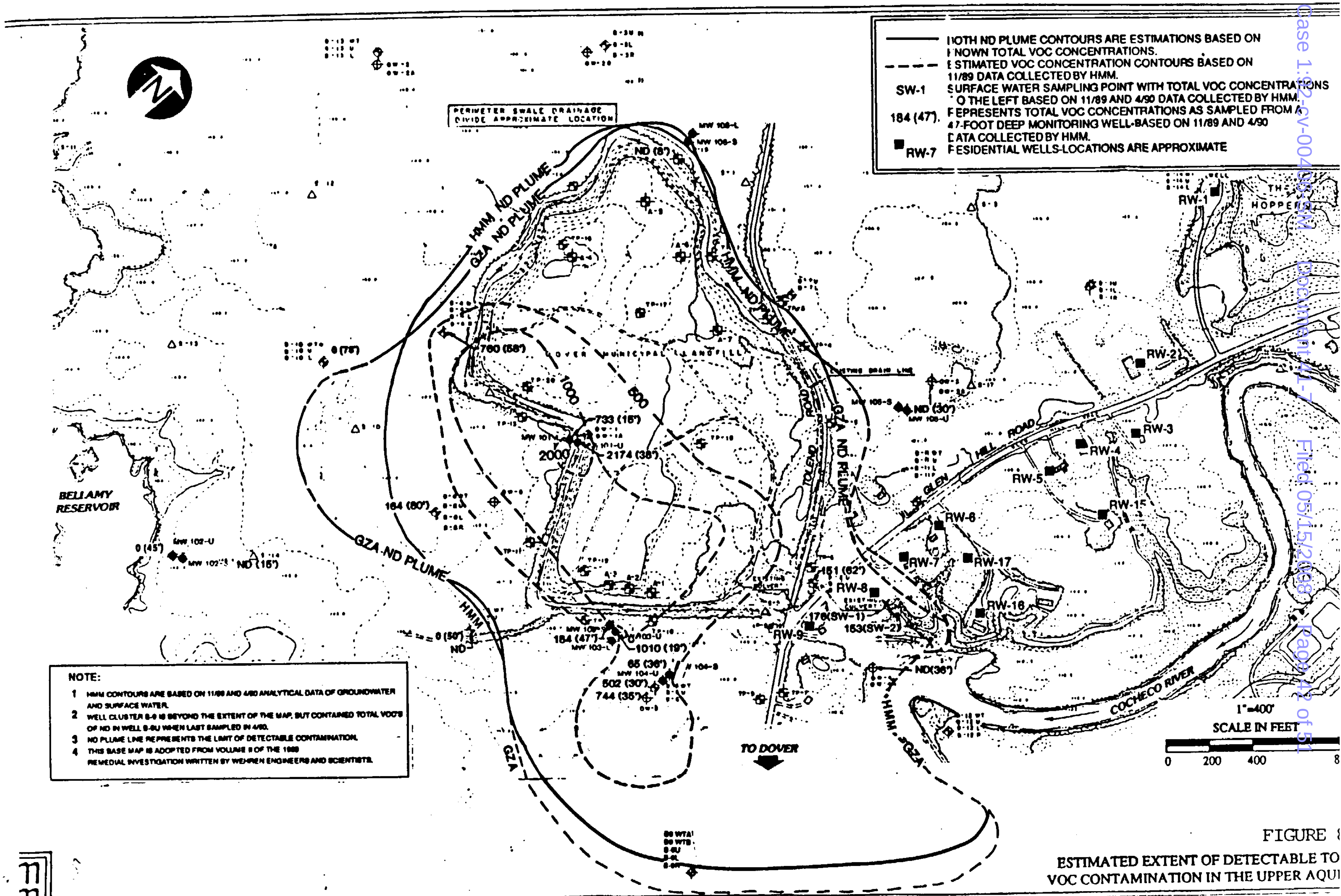


FIGURE 8

ESTIMATED EXTENT OF DETECTABLE TO
VOC CONTAMINATION IN THE UPPER AQU

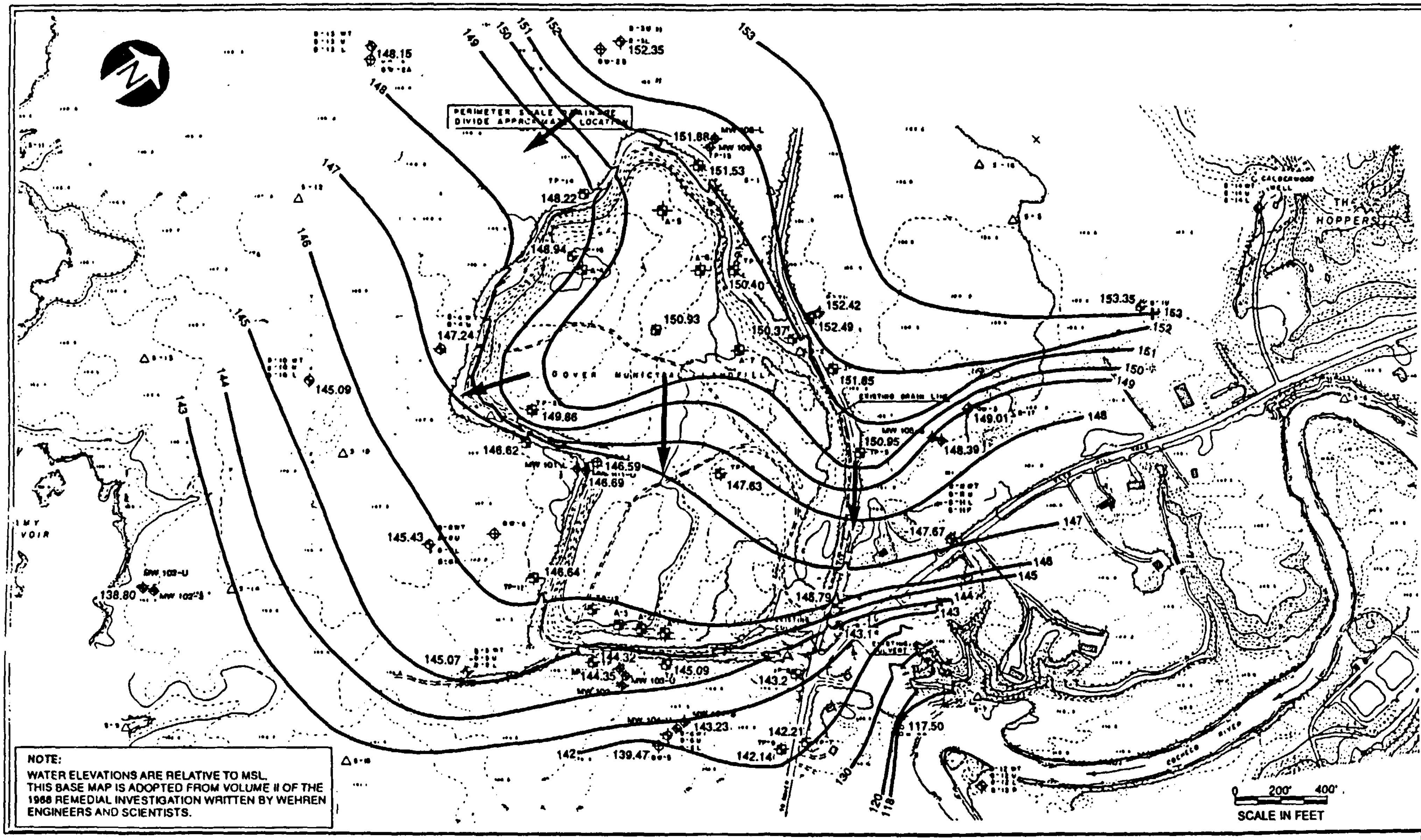


FIGURE 9
WATER ELEVATION CONTOUR MAP
MARCH, 1990 U R AQUIFER

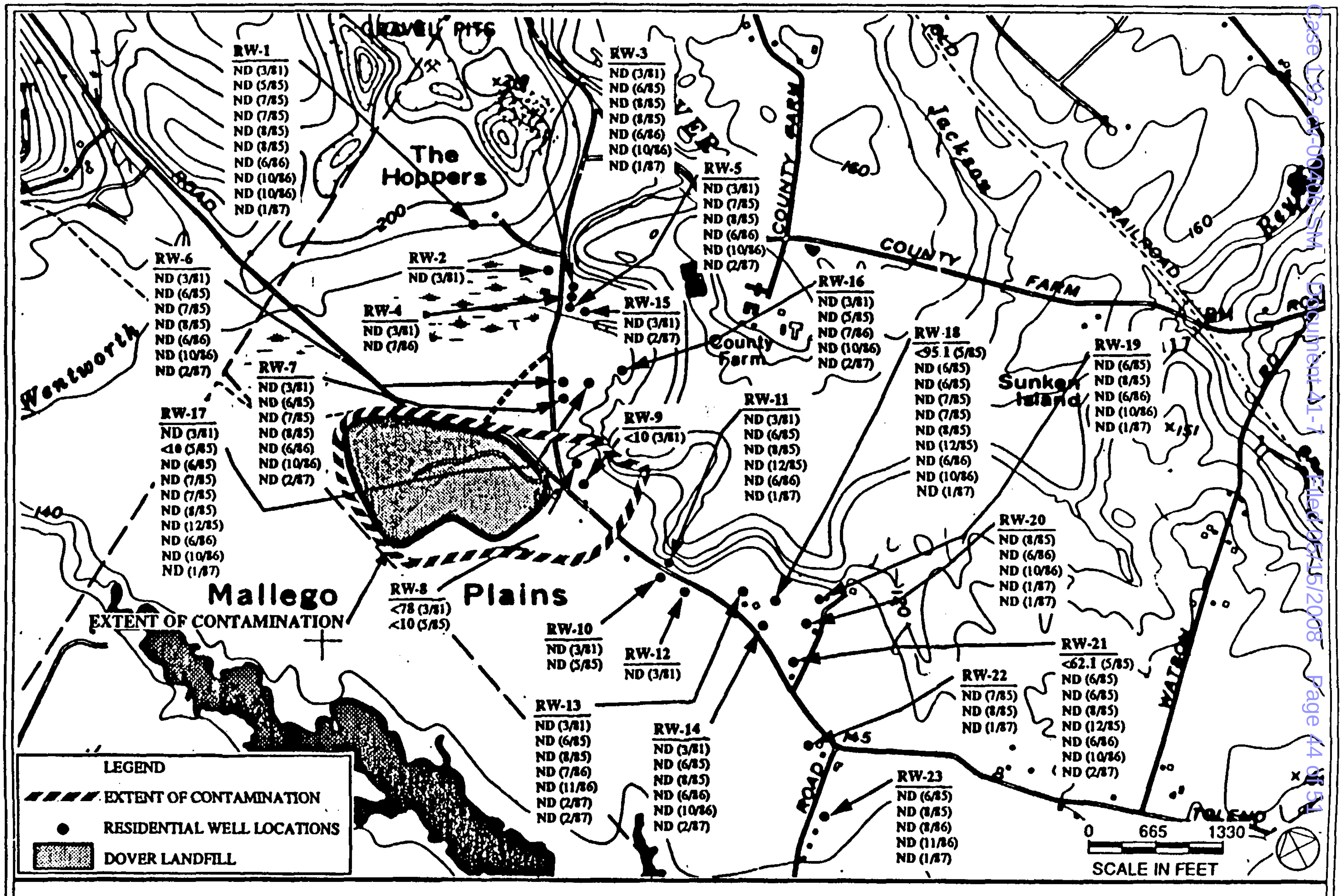


FIGURE 10

EXPANDED EXTENT OF CONTAMINATION PLUME AND RESIDENTIAL WELL WATER QUALITY

FIGURE 11

Typical Multi-layer Cap Cross Section

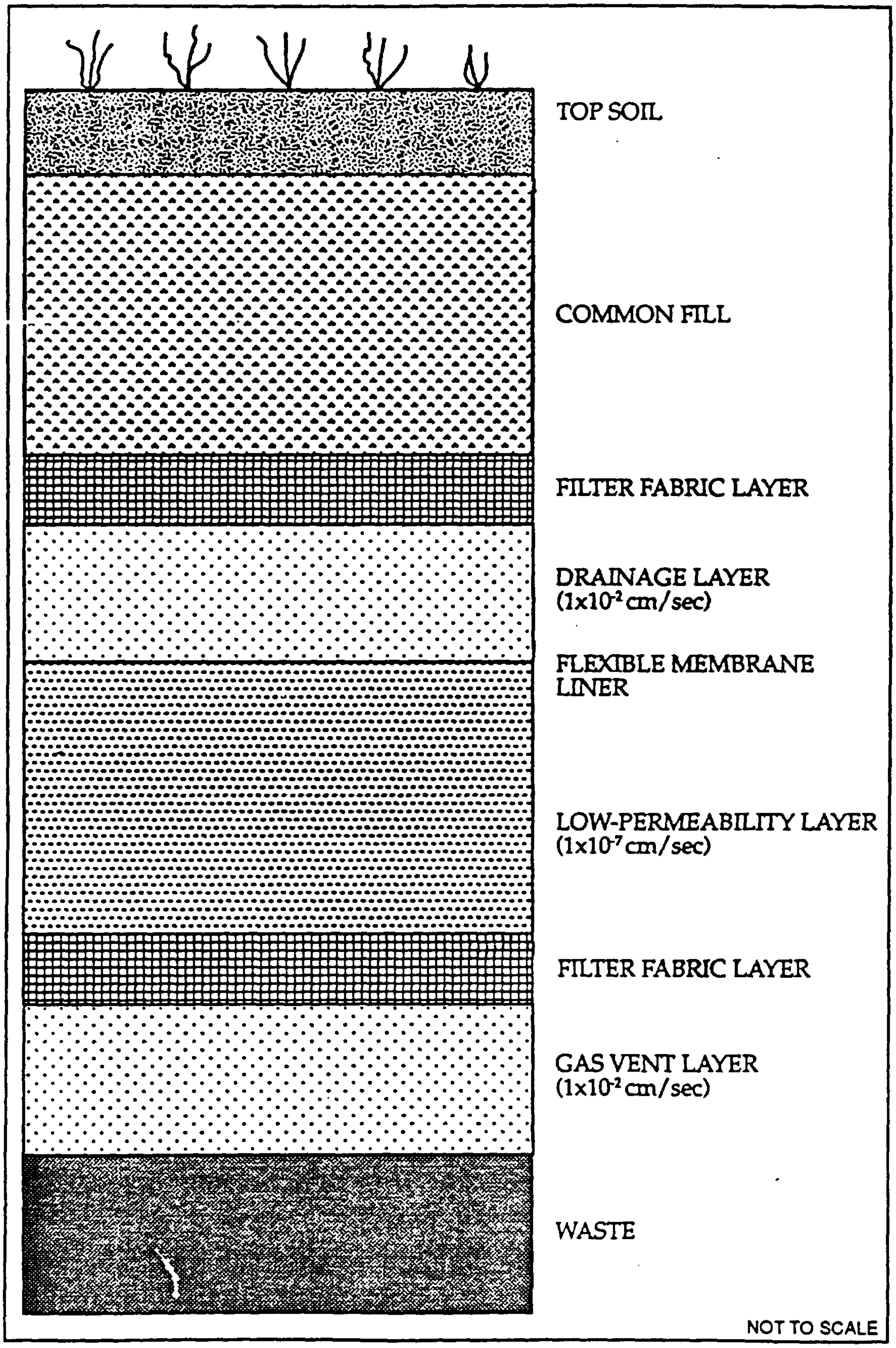


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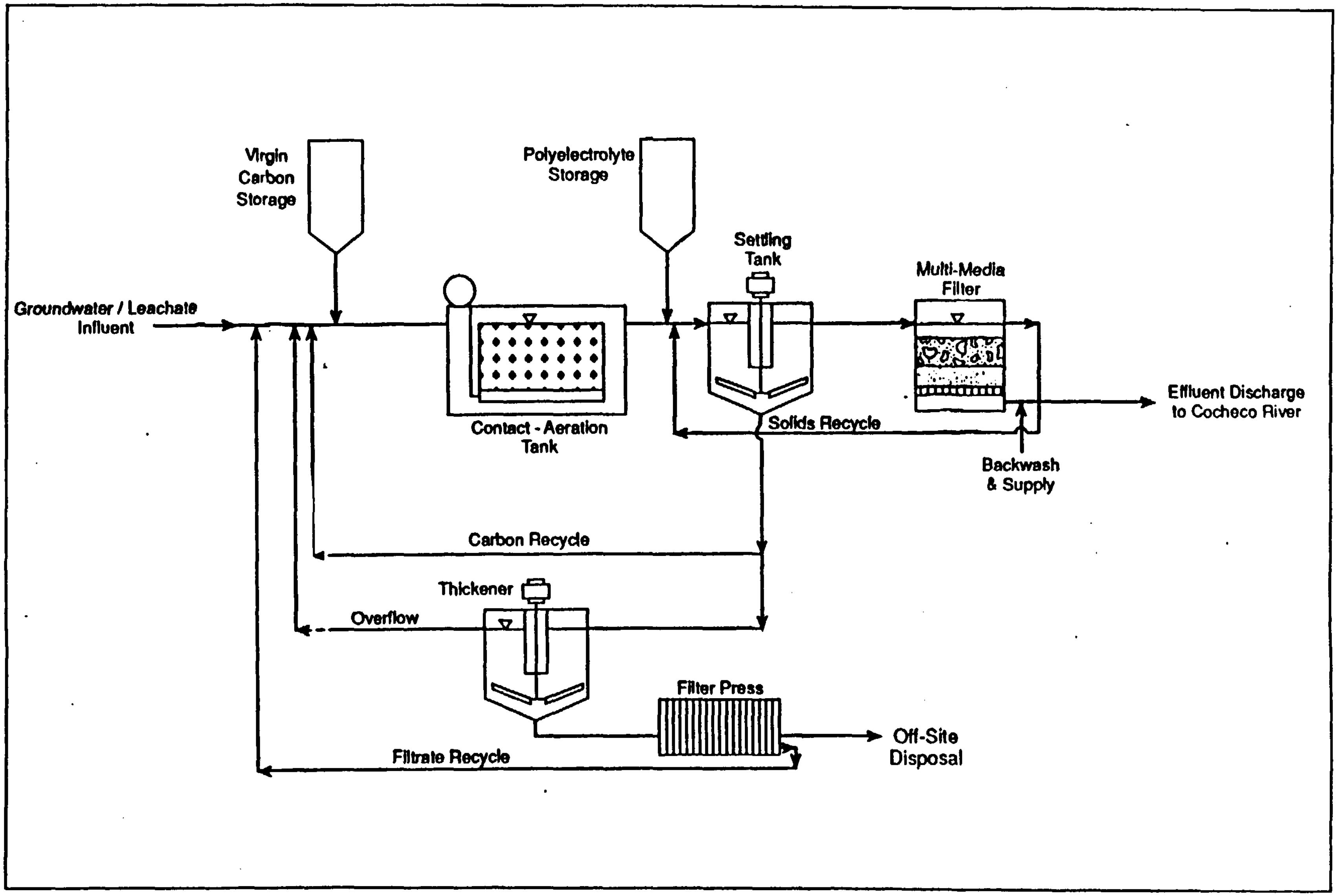
FIGURE 12

Proposed Groundwater/Leachate Treatment General Process Diagram



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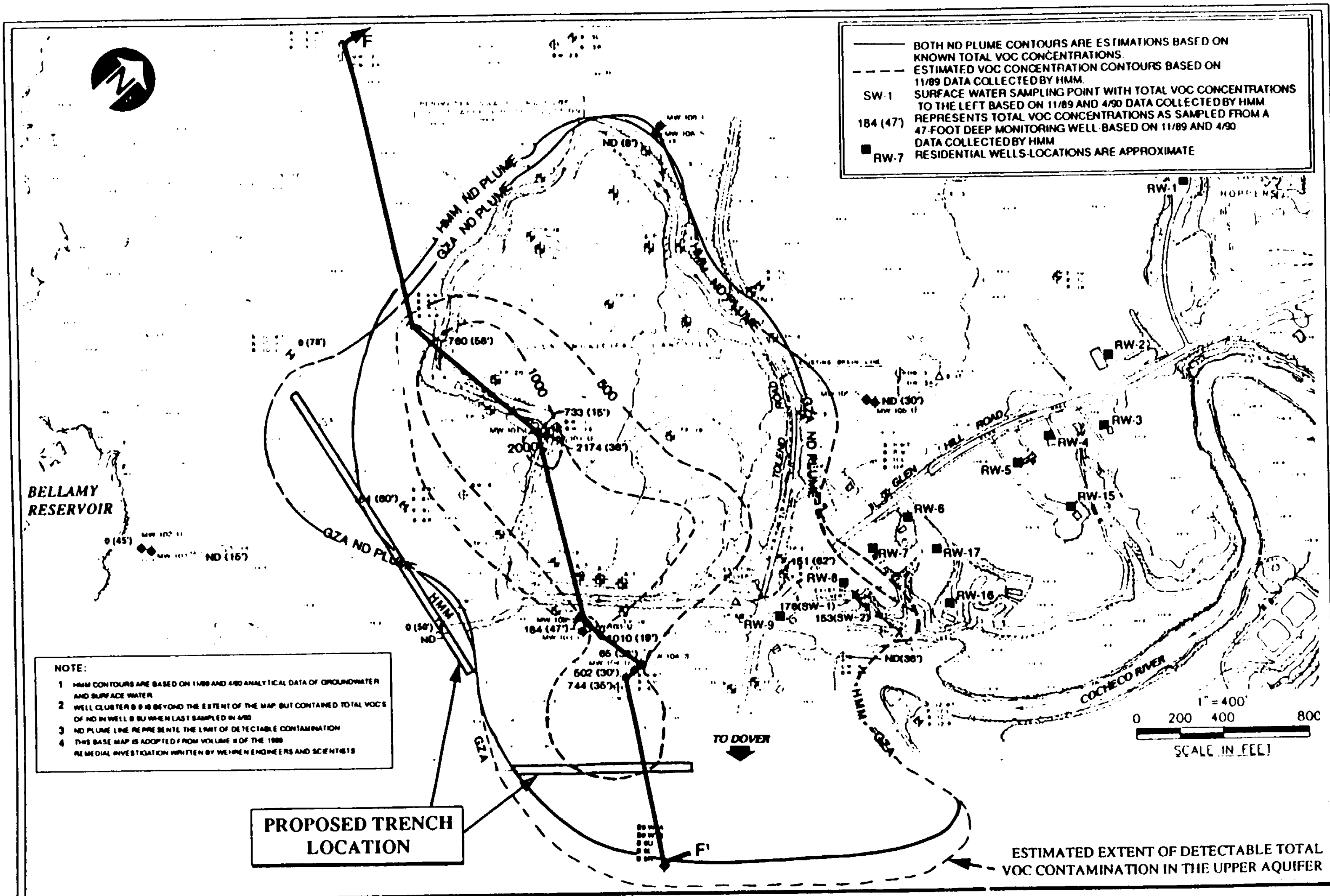

FIGURE 13
MM-3: CONCEPTUAL (OFF-SITE) GROUNDWATER INTERCEPTOR TRENCH LOCATION MAP

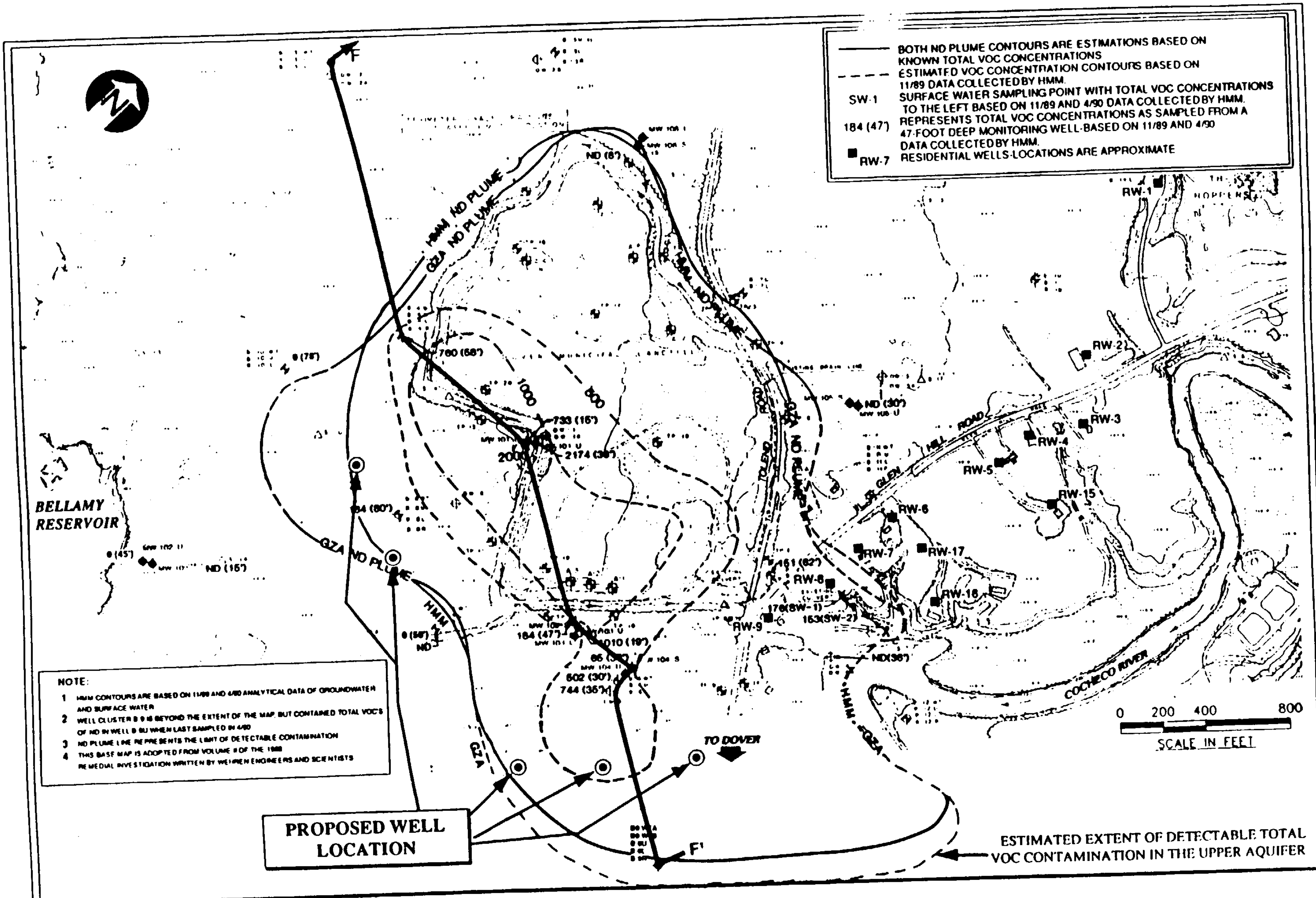

FIGURE 14
MM-4: CONCEPTUAL (OFF-SITE) GROUNDWATER EXTRACTION WELL LOCATION MAP

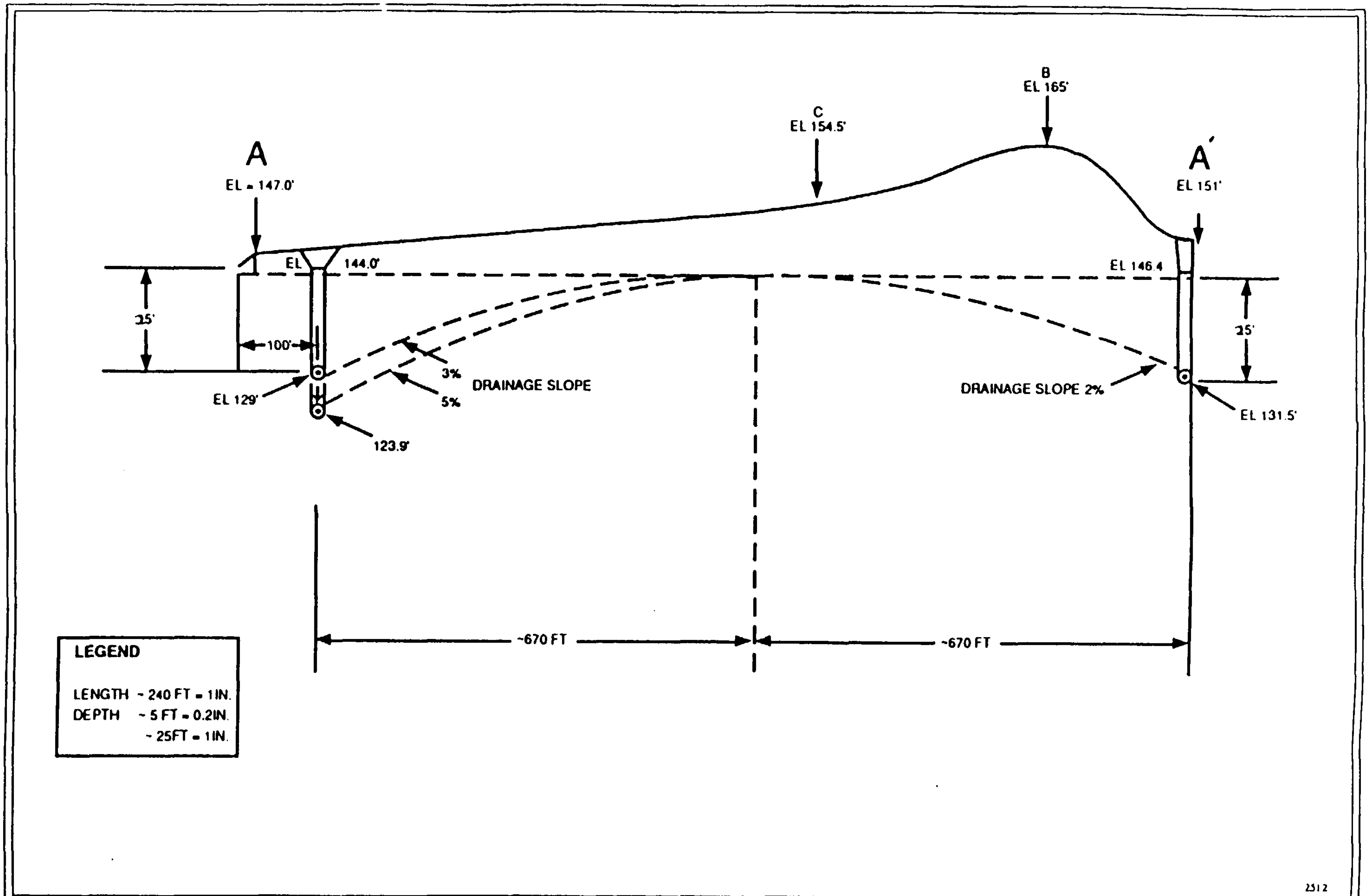

FIGURE 15
CONCEPTUAL GROUNDWATER DEPRESSION
INTERCEPTOR TRENCH

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Appendix B

TABLES

TABLE 1 INDUSTRIAL WASTE SURVEY
TABLE 2 CONTAMINANTS OF CONCERN

RISK ESTIMATES:
TABLE 3 FUTURE USE OF GROUNDWATER
TABLE 4 FUTURE USE OF BELLAMY RESERVOIR
TABLE 5 INGESTION OF SURFACE WATER - COCHECO RIVER
TABLE 6 DERMAL CONTACT WITH SURFACE WATER - COCHECO RIVER
TABLE 7 DERMAL CONTACT SURFACE WATER - SWALE
TABLE 8 INGESTION AND DERMAL CONTACT WITH SEDIMENTS - SWALE

TABLE 9 PRETREATMENT REQUIREMENTS

TABLE 1
INDUSTRIAL WASTE SURVEY (1976-1977)
DOVER MUNICIPAL LANDFILL

Waste Material	Quantity/Year	Waste Material	Quantity/Year
Plastics	144 yd. & 57,200 lb.	Oil	6,260 gal.
Urethane foam	1,860 gal.	Ink	10 lb.
Paper	3,468 yd^3 & 30 tons	Lacquer	12 gal.**
Cardboard	1,548 yd^3 & 18 tons	Film developer	30 gal.**
Varnish	132 gal.	Hypocleaning agent	32.5 gal.**
Hydraulic oil	300 gal.	Glacial acetic acid	2 gal.**
Synthetic plastic	3,120 yd^3	Color stabilizer	15 gal.**
Leather trimmings	4,160 yd^3	Paper developer	6 gal.**
Fiberboard	1,872 yd^3	Kerosene	208 gal.
Wood	5 yd.	Wooden boxes	520 yd^3
Paint sludge	169,380 gal.	"Crepe trimming"	1,040 yd^3
Cement sludge	3 yd^3	Polyurethane foam	104 yd^3
Paint filters	16,432 ft^2	"PVC box filter"	12 yd^3
Plastersol	2,860*	Fabricated plastic	1,560 yd^3
Solvents	1,100 gal.	Galvanized steel	78 yd^3
MEK (Methyl Ethyl Ketone)	Unknown	Polyethylene	130,000 lb.
Triethanolamine	Unknown	Fiberglass	1,200 lb.
Isopropyl Alcohol	Unknown	Sawdust	204 yd^3
Diethylene glycol	Unknown	"Leather trim"	91.25 ton
Anhydrous butadiol	Unknown	"Chrome leather shavings	3,650 yd^3
Urethane elastomer	Unknown	"Chrome trim"	104 yd^3
Cutting Oil	500 gal.	Tanning sludge	78,000*
"Turco Vitroclean"	30 gal.	"Chem tan H"	156 lb.
"Turco 4432"	30 gal.	Leather scraps	5,200 yd^3
"Turco 4368"	30 gal.	Degreaser	600 gal.
"Witch Oil"	Unknown	Toluene	2,860 gal.
"Black Passiwater"	Unknown	Plating rinse	130 gal.
Xylol toluol	Unknown	Plating filter media	780 lb.
Spent hydrochloric acid	540 gal.	Paint thinner	Unknown
Tin	104 yd^3	Spent hydrofluoric acid	180 gal.
Emulsifier sludge	52 yd^3	Spent nitric acid	360 gal.
"Cellular crepee"	416 yd^3	Caustic soda	12,000 lb.
Latex cement sludge	130 yd^3	Mold wax	240 lb.
Leather	180 yd^3	Mold material	862 tons
Rubber	360 yd^3	Dust collection sludge	45,375 gal.

Notes:

1. Table 1 has been compiled from the "Remedial Action Master Plan, Dover Municipal Landfill, Dover, New Hampshire" prepared by NUS Corporation of Pittsburgh, Pennsylvania in September, 1983.

2. A total of 6,468 drums per year were noted in this New